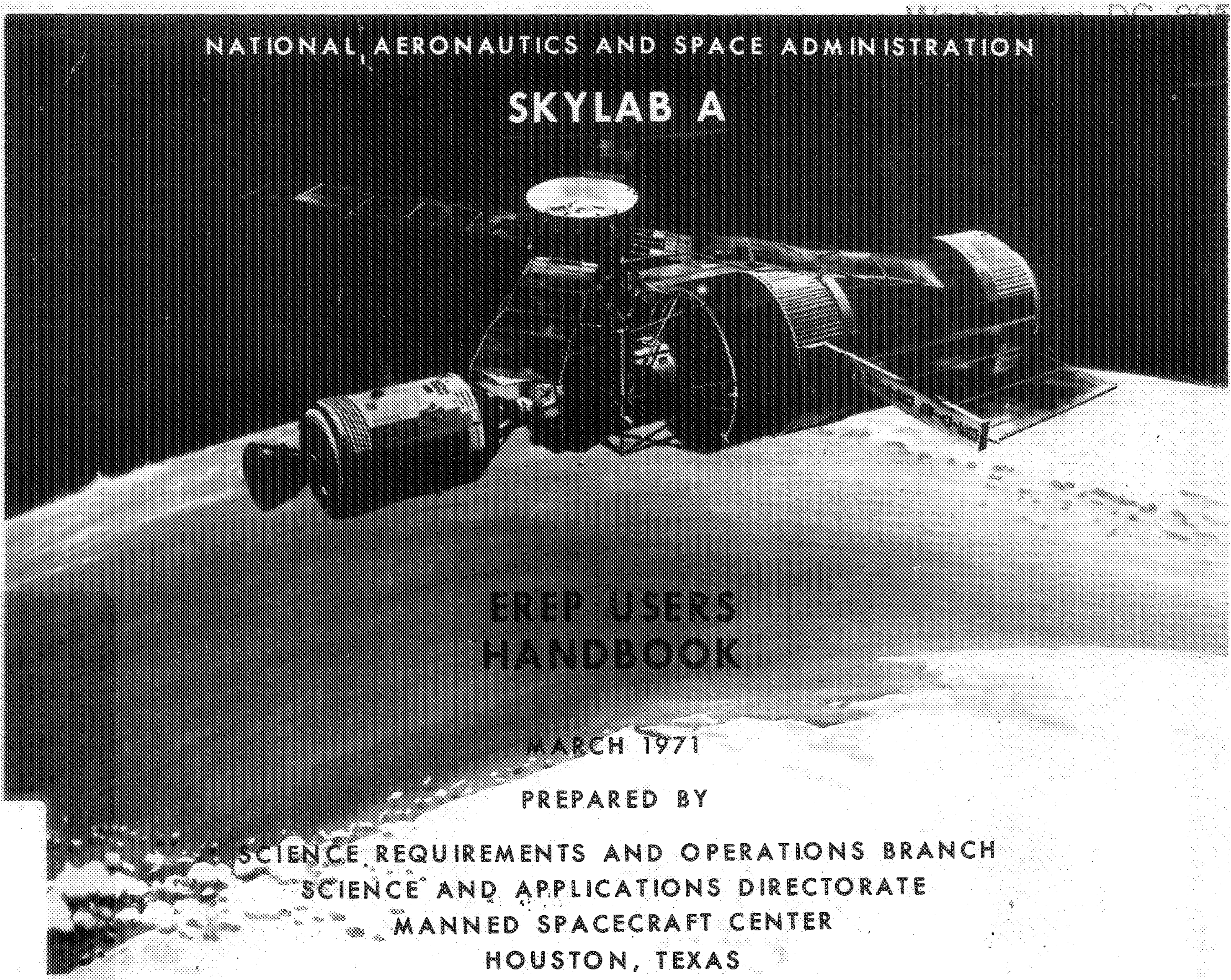
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SKYLAB A



EREP USERS HANDBOOK

MARCH 1971

PREPARED BY

SCIENCE REQUIREMENTS AND OPERATIONS BRANCH
SCIENCE AND APPLICATIONS DIRECTORATE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Page intentionally left blank

NASA-S-71-13209-F

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: TD5

MEMORANDUM TO: All EREP Users and Investigators

FROM : TD5/Chief, Science Requirements and Operations Branch

SUBJECT : Revised EREP Users Handbook

The enclosed handbook has been revised since the EREP users workshop held at Goddard Space Flight Center in February. We have incorporated most of the suggestions received and feel that the contents will aid you in preparing your proposals as well as be an informative reference document.

The Science Missions Support Division is representing your interest in the Science and Applications Directorate and we urge you to call on us for that support as needed. We look forward to working with you on Skylab and feel free to contact us at Area Code 713, telephone 483-5851 for further assistance.

Manfred H von Ehrenfried

Manfred H. von Ehrenfried

Enclosure

Page intentionally left blank

CONTENTS

CONTENTS

CONTENTS

CONTENTS

NASA-S-71-12801-V

ACRONYMS AND ABBREVIATIONS

Page intentionally left blank

ACRONYMS AND ABBREVIATIONS

Å	ANGSTROM UNIT (ONE TEN-BILLIONTH OF A METER)
AA	NASA ASSOCIATE ADMINISTRATOR
ABS	ABSOLUTE
A/C	AIRCRAFT
A/D	ANALOG-TO-DIGITAL
AFO	ANNOUNCEMENT OF FLIGHT OPPORTUNITIES
AGC	AUTOMATIC GAIN CONTROL
AM	AIRLOCK MODULE
ASP	ACTIVITIES SCHEDULING PROGRAM
ASPO	APOLLO SPACECRAFT PROGRAM OFFICE
ATM	APOLLO TELESCOPE MOUNT
AUTO	AUTOMATIC
BPS	BITS PER SECOND
°C	DEGREES CENTIGRADE
CAAD	COMPUTATION AND ANALYSIS DIVISION
CAL	CALIBRATE
CB	CIRCUIT BREAKER
CCB	CONFIGURATION CONTROL BOARD
CCIG	COLD-CATHODE ION GAGE
CDR	CRITICAL DESIGN REVIEW
CM	COMMAND MODULE
cm	CENTIMETER
CTC	CROSS TRACK CONTIGUOUS
CSM	COMMAND AND SERVICE MODULE
CTNC	CROSS TRACK NON CONTIGUOUS
db	DECIBEL
dc	DIRECT CURRENT
DECL	DECLINATION (MEASURED IN CELESTIAL COORDINATES)
DEG	DEGREE
DRF	DATA REQUEST FORM
DSE	DATA STORAGE EQUIPMENT
DTO	DETAILED TEST OBJECTIVE
E	EAST
EAFB	ELLINGTON AIR FORCE BASE
ED	COMPUTATION AND ANALYSIS DIVISION
EMI	ELECTROMAGNETIC INTERFERENCE
EPS	ELECTRIC POWER SYSTEM
ERAP	EARTH RESOURCES AIRCRAFT PROJECT
EREP	EARTH RESOURCES EXPERIMENT PACKAGE
ERSP	EARTH RESOURCES SURVEY PROGRAM

ACRONYMS AND ABBREVIATIONS (CONT)

ERSP/RC	ERSP - REVIEW COMMITTEE
ERTS	EARTH RESOURCES TECHNOLOGY SATELLITE
ESSA	ENVIRONMENTAL SCIENCES SERVICE ADMINISTRATION
EVA	EXTRAVEHICULAR ACTIVITY
F	FAHRENHEIT
FCSD	FLIGHT CREW SUPPORT DIVISION
FM	FREQUENCY MODULATED
FMC	FORWARD MOTION COMPENSATION
FOD	FLIGHT OPERATIONS DIRECTORATE
FPS	FEET PER SECOND
FOM	FLIGHT OPERATIONS MANAGEMENT ROOM
GET	GROUND ELAPSED TIME
GMT	GREENWICH MEAN TIME
GSFC	GODDARD SPACE FLIGHT CENTER
G/T	GROUND TRUTH
HD	HIGHLY DESIRABLE
HR	HOUR
HQ.	HEADQUARTERS
ID	IDENTIFICATION
IMU	INERTIAL MEASUREMENT UNIT
ITC	IN TRACT CONTIGUOUS
ITNC	IN TRACT NON CONTIGUOUS
IR	INFRARED
IU	INSTRUMENT UNIT
IV	INTERVALOMETER
IVA	INTRAVEHICULAR ACTIVITY
K	KELVIN
kg	KILOGRAM
kHz	KILOHERTZ
km	KILOMETER
KSC	KENNEDY SPACECRAFT CENTER
kV	KILOVOLT
LSB	LEAST SIGNIFICANT BIT
m	METER
M	MANDATORY
MCC	MISSION CONTROL CENTER
MDA	MULTIPLE DOCKING ADAPTER
MHz	MEGAHERTZ
MIL-STD	MILITARY STANDARD
MIN	MINUTE
mm	MILLIMETER
MODEM	MODULATION DEMODULATION PACKAGE

ACRONYMS AND ABBREVIATIONS (CONT)

MOPS/ASP	MISSION OPERATIONS PLANNING SYSTEM/ACTIVITIES SCHEDULING PROGRAM
MPAD	MISSION PLANNING AND ANALYSIS DIVISION
MRD	MISSION REQUIREMENTS DOCUMENT
MSC	MANNED SPACECRAFT CENTER
MSFC	MARSHALL SPACE FLIGHT CENTER
MSFEB	MANNED SPACE FLIGHT EXPERIMENTS BOARD
MSFN	MANNED SPACE FLIGHT NETWORK
MSL	MAPPING SCIENCE LABORATORY
MSPD	MISSION SCIENCE PLANNING DOCUMENT
mV	MILLIVOLT
mμ	MILLIMICRON
N	NORTH
n	NEWTON
N/A	NOT APPLICABLE
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NAVOCEANO	NAVAL OCEANOGRAPHIC OFFICE
NM	NAUTICAL MILE
NO.	NUMBER
NSSL	NATIONAL SEVERE STORM LABORATORY
OA	ORBITAL ASSEMBLY
OMSF	OFFICE OF MANNED SPACE FLIGHT
OSSA	OFFICE OF SPACE SCIENCES AND APPLICATION
OWS	ORBITING WORK SHOP
PAD	PREADVISORY DATA
PCM	PULSE CODE MODULATION
PI	PRINCIPAL INVESTIGATOR
PTC	PASSIVE THERMAL CONTROL
PTL	PHOTOGRAPHIC TECHNOLOGY LABORATORY
RAD/SCAT	RADIOMETER AND SCATTEROMETER
R. ASC.	RIGHT ASCENSION (MEASURED IN CELESTIAL COORDINATES)
RCS	REACTION CONTROL SYSTEM
RF	RADIO FREQUENCY
RPM	REVOLUTIONS PER MINUTE
RTC	REAL TIME COMMAND
RTCC	REAL TIME COMPUTER COMPLEX
S	SOUTH
SA	SATURN APOLLO

ACRONYMS AND ABBREVIATIONS (CONT)

SAL	SCIENTIFIC AIRLOCK
S&AD	SCIENCE AND APPLICATIONS DIRECTORATE
SEC	SECOND
SM	SERVICE MODULE
SMSD	SCIENCE MISSIONS SUPPORT DIVISION
SPS	SERVICE PROPULSION SYSTEM
SPS	SAMPLES PER SECOND
SROB	SCIENCE REQUIREMENTS AND OPERATIONS BRANCH
SR	EARTH OBSERVATIONS PROGRAM DIR.
S.S.	SEA STATE
SSR	STAFF SUPPORT ROOM
SS&A	SPACE SCIENCE & APPLICATIONS
SST	SCIENCE SUPPORT TEAM
STA	STATION
STS	SCIENTIFIC TEST SITE
TBD	TO BE DETERMINED
TBS	TO BE SUPPLIED
TEMP	TEMPERATURE
TF	EARTH OBSERVATION DIVISION
TH	SULAR AND EARTH SCIENCES DIVISION
TK	EARTH ORBITAL MISSIONS OFFICE
TM	TELEMETRY
TORR	UNIT OF PRESSURE (1/760 OF AN ATMOSPHERE 0.757 X 10^{-2} N/M^2)
TV	TELEVISION
USB	UNIFIED S-BAND
USGS	UNITED STATES GEOLOGICAL SURVEY
UV	ULTRAVIOLET
V	VOLT
VCO	VOLTAGE CONTROLLED OSCILLATOR
V dc	VOLTS OF DIRECT CURRENT
VHF	VERY HIGH FREQUENCY
V/TS	VIEWFINDER TRACKING SYSTEM
W	WEST
X	MAGNIFICATION FACTOR
XMTR	TRANSMITTER
Z-LV	Z-AXIS IN LOCAL VERTICAL DIRECTION
h	HOUR (SUPERSCRIPT)
m	MINUTE (SUPERSCRIPT)
γ	GAMMA
μ	MICRON
°	DEGREES

NASA-S-71-12619-V

SKYLAB PROGRAM

Page intentionally left blank

DESCRIPTION

- THE SKYLAB PROGRAM WILL ESTABLISH, EQUIP, AND MAINTAIN AN ORBITING MANNED WORKSHOP
- ALL FLIGHT ACTIVITIES WILL BE IN NEAR-EARTH ORBIT AT ALTITUDES UP TO 235 N. MI.
- THE CREW WILL PERFORM A BROAD RANGE OF SCIENTIFIC AND TECHNOLOGICAL EXPERIMENTS
- SKYLAB MISSIONS WILL EXTEND THE DURATION OF MANNED SPACE FLIGHTS
  - FIRST MISSION WILL BE FOR UP TO 28 DAYS
  - TWO SUBSEQUENT REVISIT MISSIONS WILL BE FOR UP TO 56 DAYS
- SKYLAB WILL MAKE MAXIMUM USE OF EXISTING GEMINI AND APOLLO HARDWARE

GENERAL FEATURES

- CURRENTLY IN DEVELOPMENT PHASE
- FLIGHT PHASE PLANNED FOR 1973
- EARTH ORBITAL
- SERIES OF FOUR LAUNCHES OVER APPROXIMATELY EIGHT MONTH PERIOD
  - 3 MANNED
  - 1 UNMANNED
- MAXIMUM UTILIZATION OF EXISTING HARDWARE AND FACILITIES

NASA-S-71-12591-V

SKYLAB OBJECTIVES

- TO STUDY THE EARTH
  - SYNOPTIC SURVEY OF SELECTED AREAS ON THE EARTH IN VISIBLE, INFRARED, AND MICROWAVE SPECTRAL WAVELENGTHS
- TO STUDY THE SUN
  - SYNOPTIC SURVEY AND STUDY OF SPECIAL PHENOMENA ON THE SOLAR DISK IN X-RAY, ULTRAVIOLET, AND VISIBLE SPECTRAL WAVELENGTHS
- TO STUDY MAN
  - DETERMINE PHYSIOLOGY CONDITIONING AND PERFORMANCE CAPABILITY IN REAL TIME IN ZERO-GRAVITY ENVIRONMENT FOR LONG-DURATION SPACE FLIGHT
- TO STUDY SPACE TECHNOLOGY
  - EVALUATE COATING DEGRADATION, SPACECRAFT CONTAMINATION, MANUFACTURING AND REPAIR TECHNIQUES, AND MANNED MANEUVERING UNITS

Page intentionally left blank

NASA-S-71-12620-V

SKYLAB HARDWARE

Page intentionally left blank

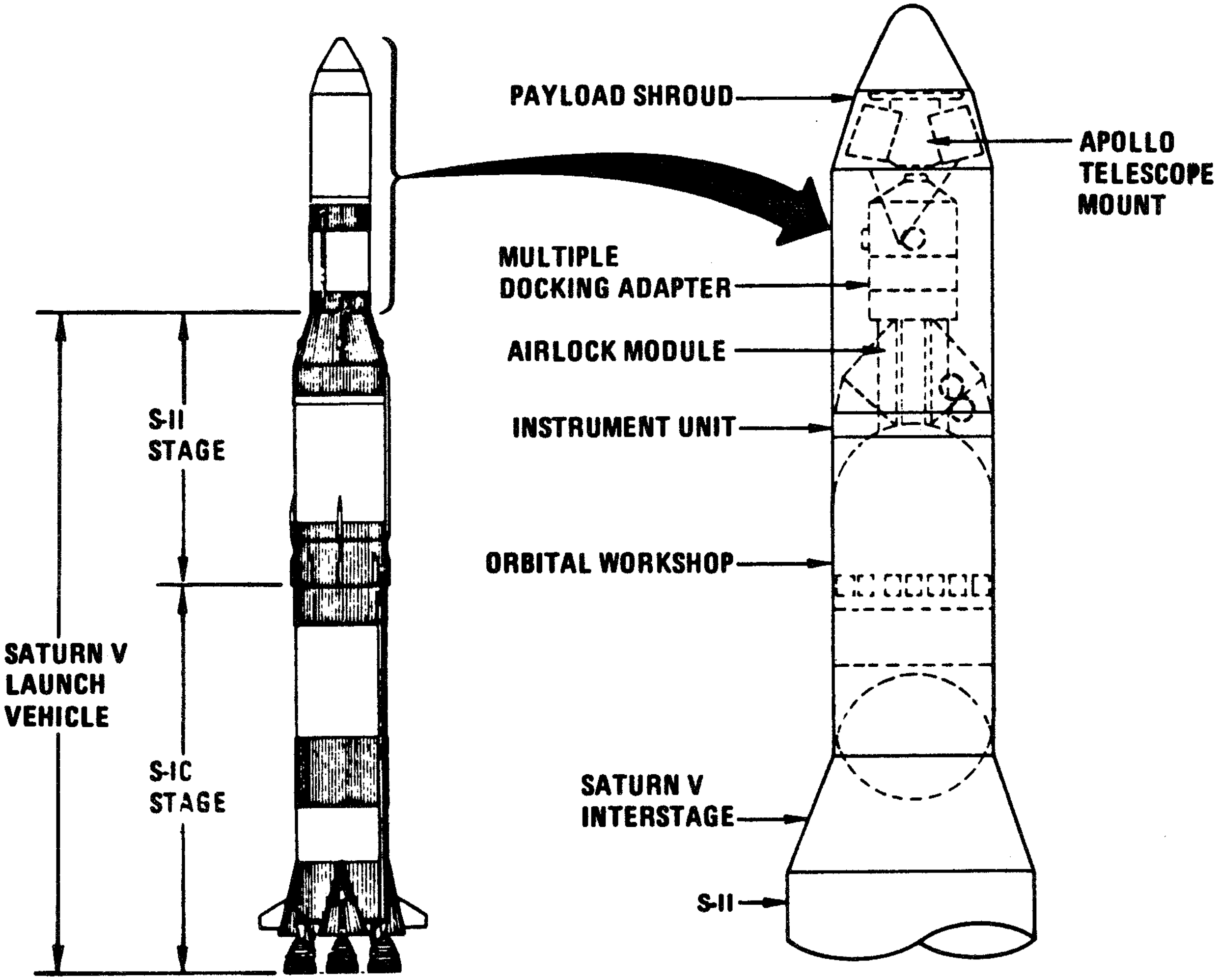
NASA-S-71-12787-V

MAJOR HARDWARE ELEMENTS

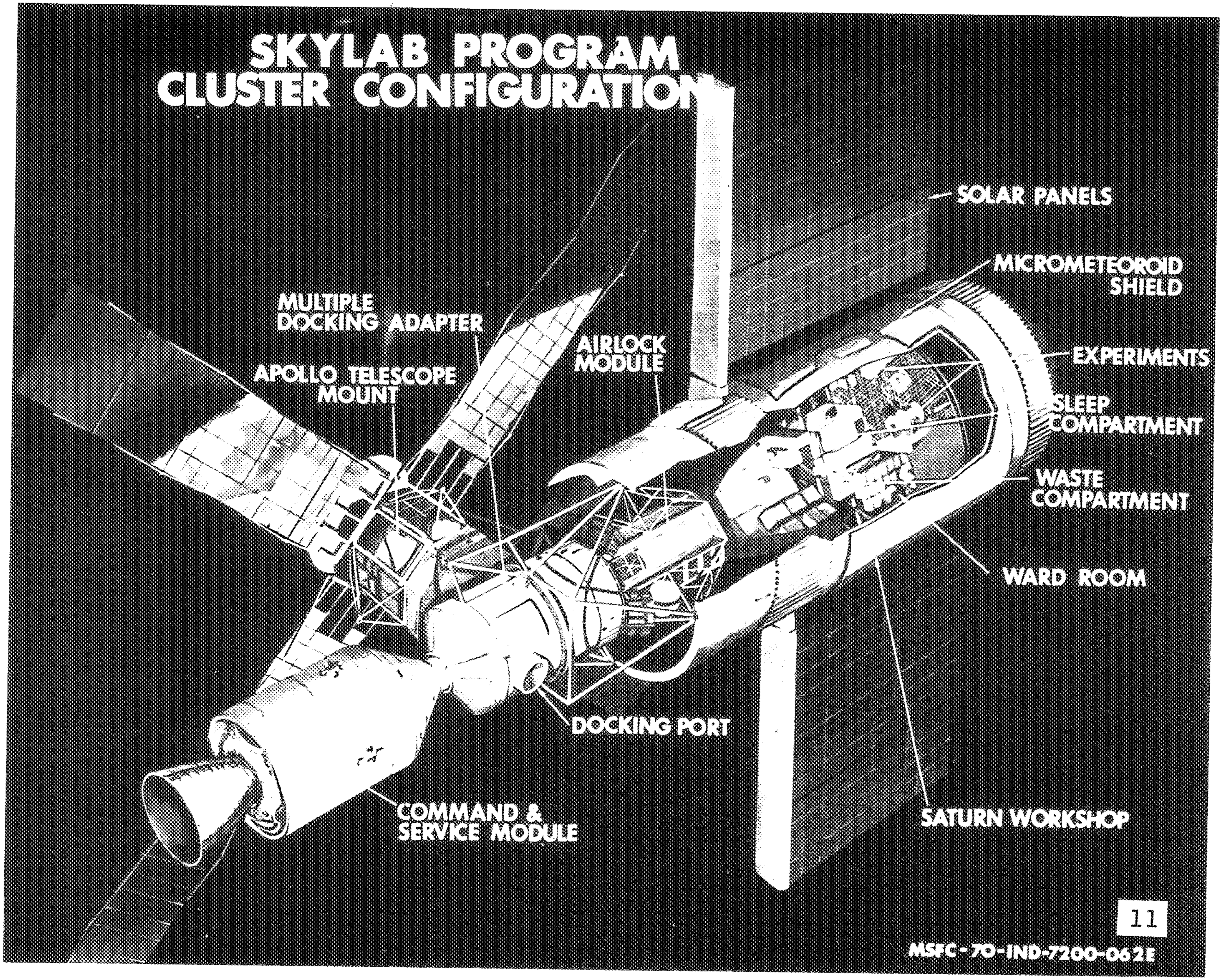
- ORBITAL WORKSHOP (OWS)
- AIRLOCK MODULE (AM)
- MULTIPLE DOCKING ADAPTER (MDA)
- APOLLO TELESCOPE MOUNT (ATM)
- COMMAND AND SERVICE MODULES (CSM)

NASA-S-71-12776-V

SKYLAB - A
LAUNCH CONFIGURATION



SKYLAB PROGRAM CLUSTER CONFIGURATION



MSFC-70-IND-7200-062E

Page intentionally left blank

NASA-S-71-12786-V

ORBITAL WORKSHOP (OWS)

Page intentionally left blank

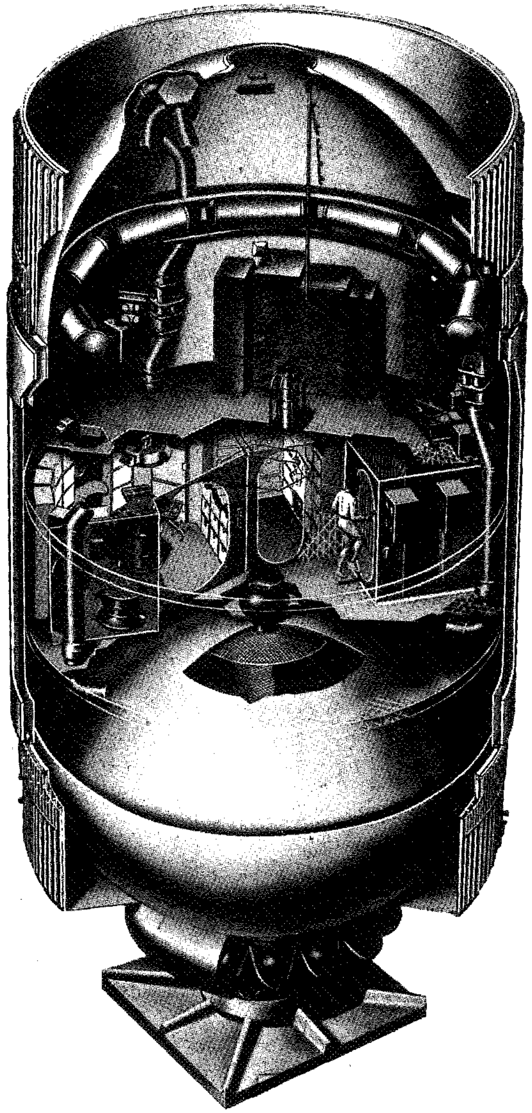
NASA-S-71-12780-V

ORBITAL WORKSHOP (OWS)

- DESCRIPTION
  - THE OWS IS A GROUND-MODIFIED S-IVB STAGE WHICH IS SUITABLE FOR LONG DURATION MANNED HABITATION IN ORBIT
- FUNCTIONS
  - PROVIDES A HABITABLE ENVIRONMENT. CREW PROVISIONS, LIVING QUARTERS, AND FACILITIES FOR FOOD PREPARATION AND WASTE MANAGEMENT WILL SUPPORT A THREE-MAN CREW FOR THREE MISSIONS (1 FOR 28 DAYS AND 2 FOR 56 DAYS EACH)
  - CAPABLE OF EXPERIMENT INSTALLATION AND STORAGE
  - PROVIDES PROPULSIVE CAPABILITY FOR CLUSTER MANEUVERABILITY
  - SUPPLIES AND ROUTES POWER FROM SOLAR ARRAY SYSTEM TO OTHER AREAS OF THE CLUSTER
  - CAPABLE OF REACTIVATION AND REUSE
- RELATED EXPERIMENTS
  - OWS EXPERIMENTS FALL IN THE AREAS OF MEDICAL, HARDWARE, AND ASTRONAUT MANEUVERABILITY EVALUATIONS. STUDIES WILL BE PERFORMED TO ASSESS THE FEASIBILITY OF LONG-TERM SUBSISTANCE IN SPACE
- RESPONSIBILITY
  - MARSHALL SPACE FLIGHT CENTER
  - McDONNELL DOUGLAS CORPORATION

NASA-S-71-12847-V

ORBITAL WORKSHOP



NASA-S-71-12793-V

AIRLOCK MODULE (AM)

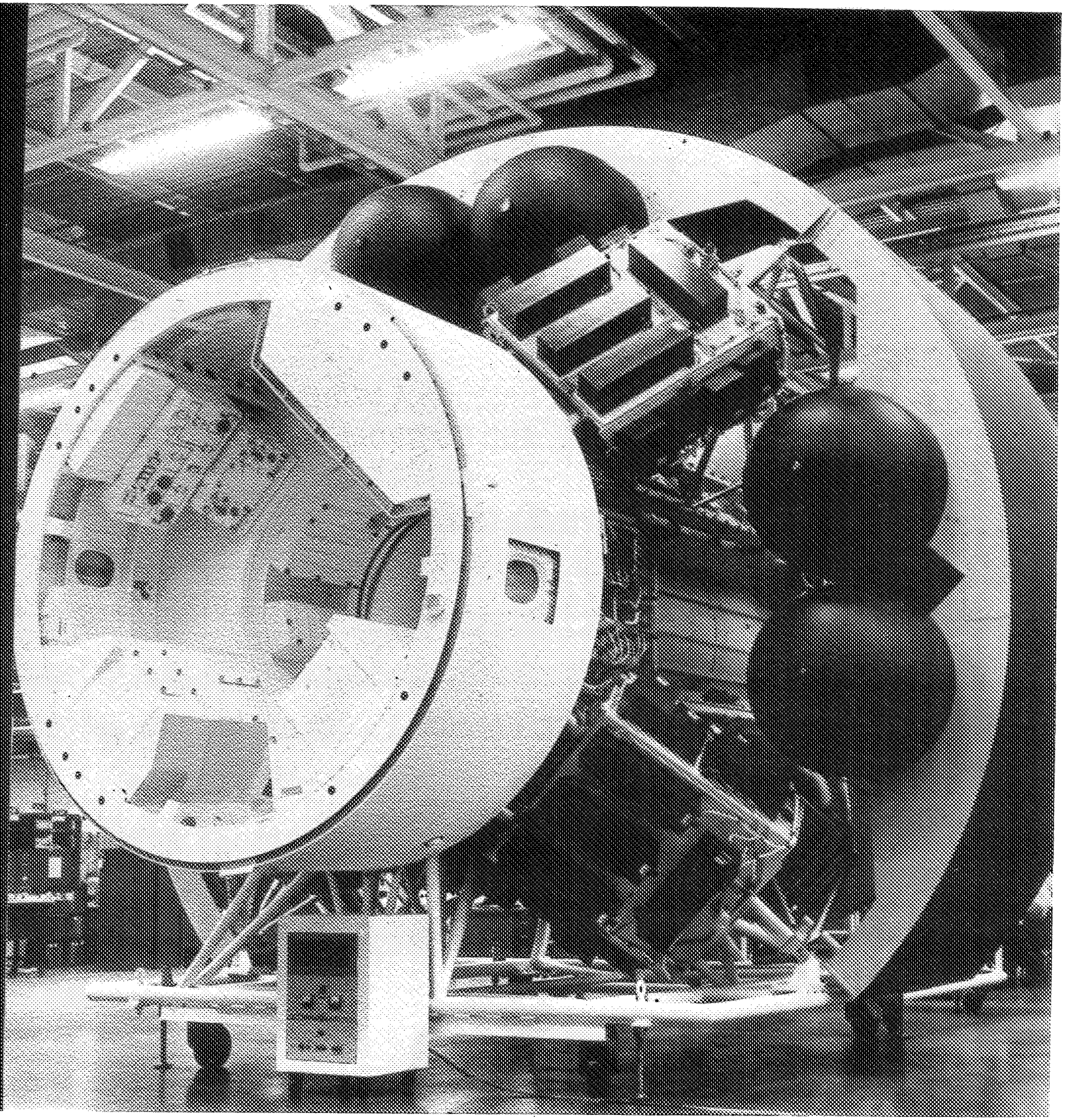
Page intentionally left blank

AIRLOCK MODULE (AM)

- DESCRIPTION
  - THE AM IS THE MAJOR WORK AREA FOR ACTIVATING AND OPERATING THE OWS. IT IS A HABITABLE INTERCONNECTING PRESSURE VESSEL BETWEEN THE OWS AND THE MULTIPLE DOCKING ADAPTER (MDA)
- FUNCTION
  - ENABLES ASTRONAUT EVA THROUGH A MODIFIED GEMINI PRESSURE HATCH
  - SUPPLIES, DISTRIBUTES, AND CONTROLS CLUSTER ATMOSPHERE AND THERMAL CONDITIONING
  - SUPPORTS THE FOLLOWING SYSTEMS
    - INTERMODULE POWER TRANSFER
    - CLUSTER COMMUNICATIONS AND DATA (INCLUDING DELAYED-TIME VOICE COMMUNICATIONS)
    - EXPERIMENTS
  - STRUCTURALLY SUPPORTS THE MDA
- EXPERIMENTS
  - MICROMETEOROID IMPACT FREQUENCY WILL BE OBTAINED BY 10 HINGED PANELS EXTERNAL TO THE AM. OTHERWISE, FEW EXPERIMENTS WILL ORIGINATE FROM THIS MODULE
- RESPONSIBILITY
  - MARSHALL SPACE FLIGHT CENTER
  - McDONNELL DOUGLAS COMPANY

NASA-S-70-481-S

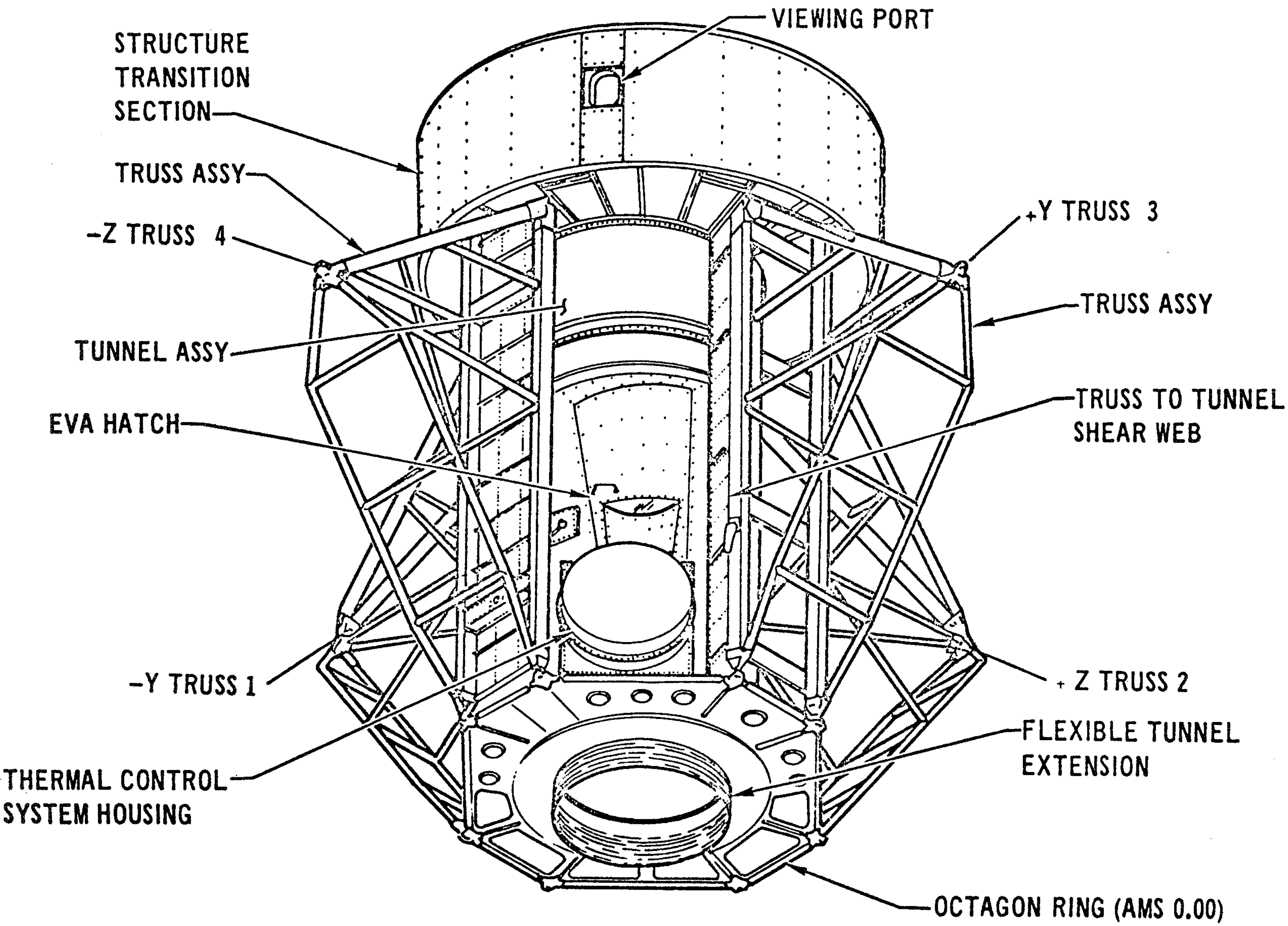
AIRLOCK MODULE MOCKUP



NASA-S-71-12795-V

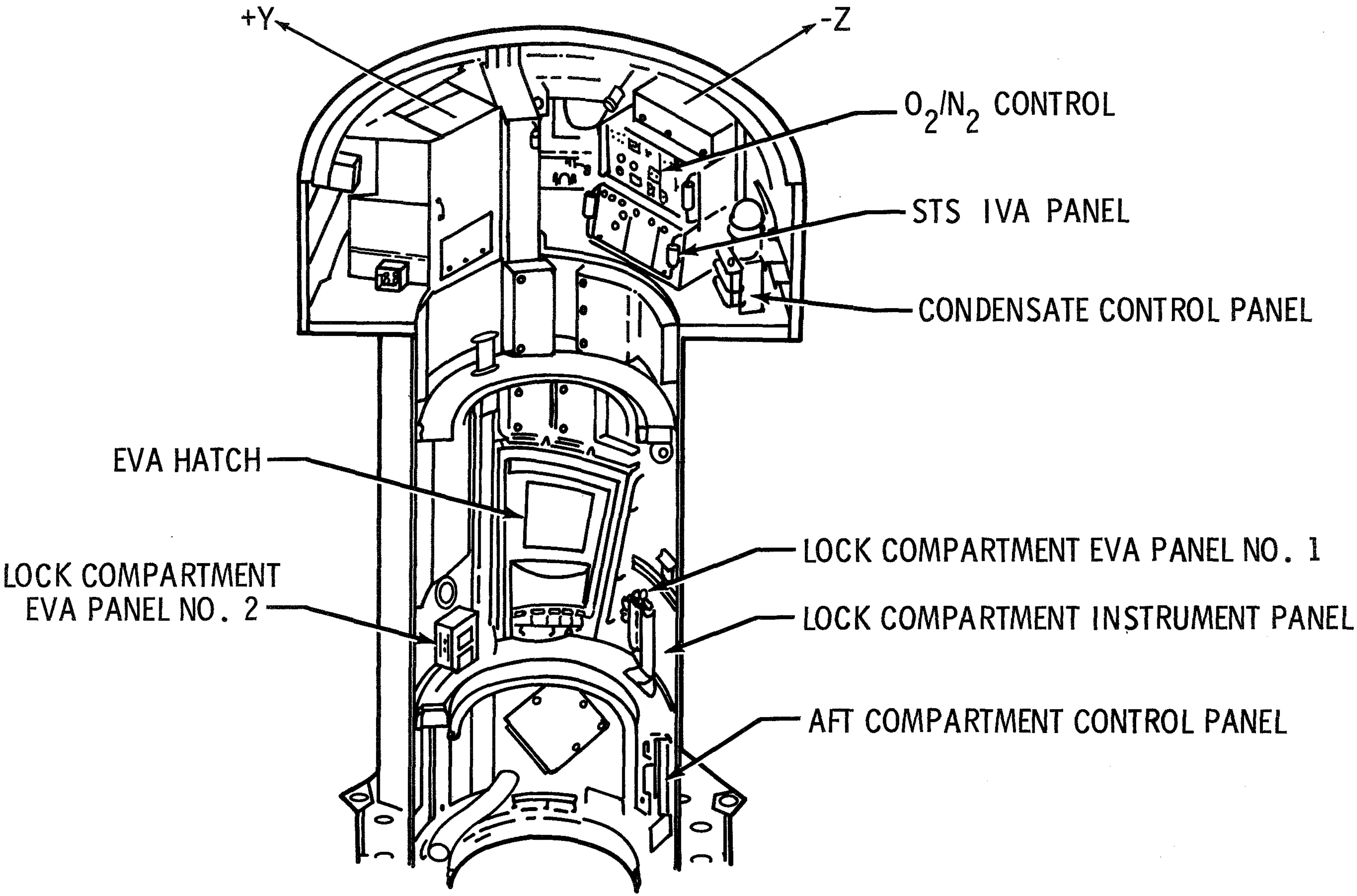
AIRLOCK

FIXED AIRLOCK SHROUD DELETED FROM THIS PICTURE FOR CLARITY



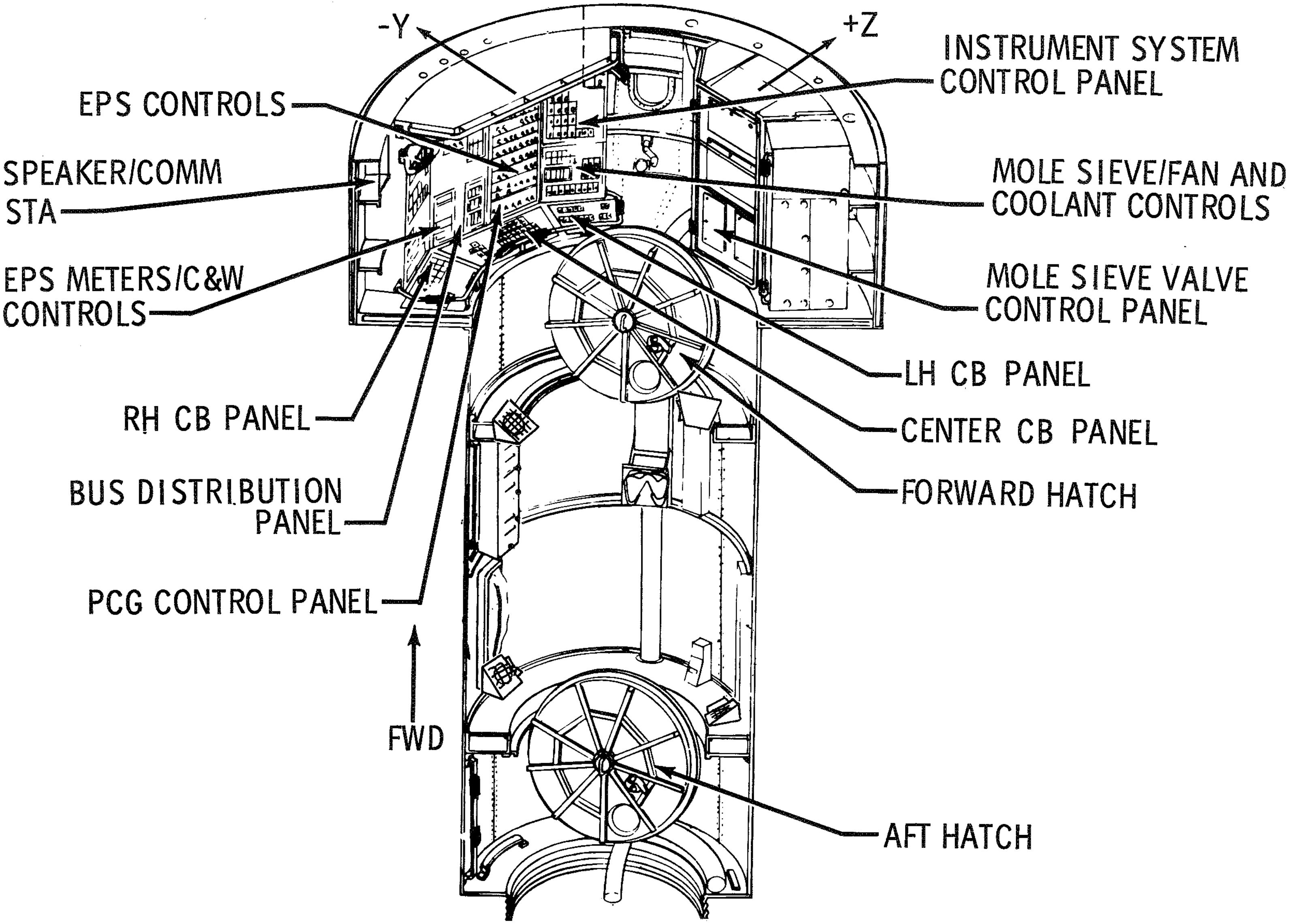
NASA-S-71-12626-V

AIRLOCK MODULE INTERNAL ARRANGEMENT



NASA-S-71-12627-V

AIRLOCK MODULE INTERNAL ARRANGEMENT



Page intentionally left blank

NASA-S-71-13259-V

MULTIPLE DOCKING ADAPTER (MDA)

Page intentionally left blank

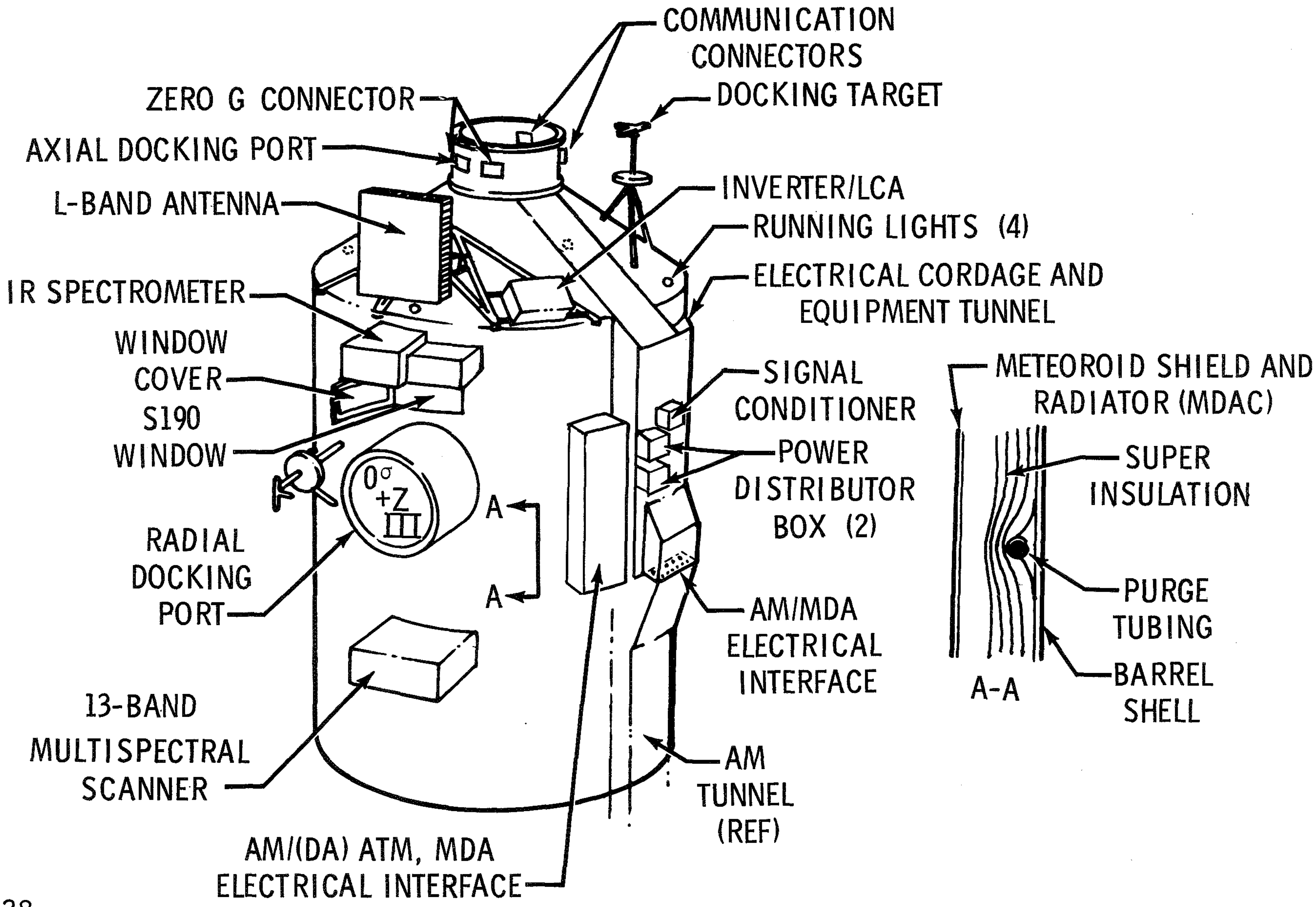
NASA-S-71-13197-V

MULTIPLE DOCKING ADAPTER (MDA)

- DESCRIPTION
  - THE MDA PROVIDES A DOCKING INTERFACE WITH THE COMMAND AND SERVICE MODULE. IT HAS TWO DOCKING PORTS, PORT 3 (RADIAL) AND PORT 5 (AXIAL)
- FUNCTIONS
  - PROVIDES A PRESSURIZED PASSAGEWAY BETWEEN THE AM AND THE DOCKED CSM
  - PORT 5 HAS COMPLETE INTERFACING EQUIPMENT AND UMBILICALS FOR INTEGRATION OF THE DOCKED CSM WITH THE CLUSTER. (PORT 3 HAS PHYSICAL DOCKING CAPABILITY ONLY)
  - HARDWARE AND EXPERIMENTS WILL BE STORED AND OPERATED IN THE MDA
  - CONTAINS THE ATM CONTROL AND DISPLAY CONSOLE TO CONTROL AND MONITOR THE THRUSTER ATTITUDE CONTROL SYSTEM AND THE ATM
  - PROVIDES STORAGE VAULTS FOR ATM FILM AND CAMERAS
  - SUPPORTS CONDUCT OF EXPERIMENT AND CREW OPERATIONS
- EXPERIMENTS
  - MOST MDA EXPERIMENTS EMPHASIZE THE STUDY OF EARTH ENVIRONMENT AND DETECTION OF EARTH RESOURCES
- RESPONSIBILITY
  - MARSHALL SPACE FLIGHT CENTER
  - MARTIN MARIETTA CORPORATION

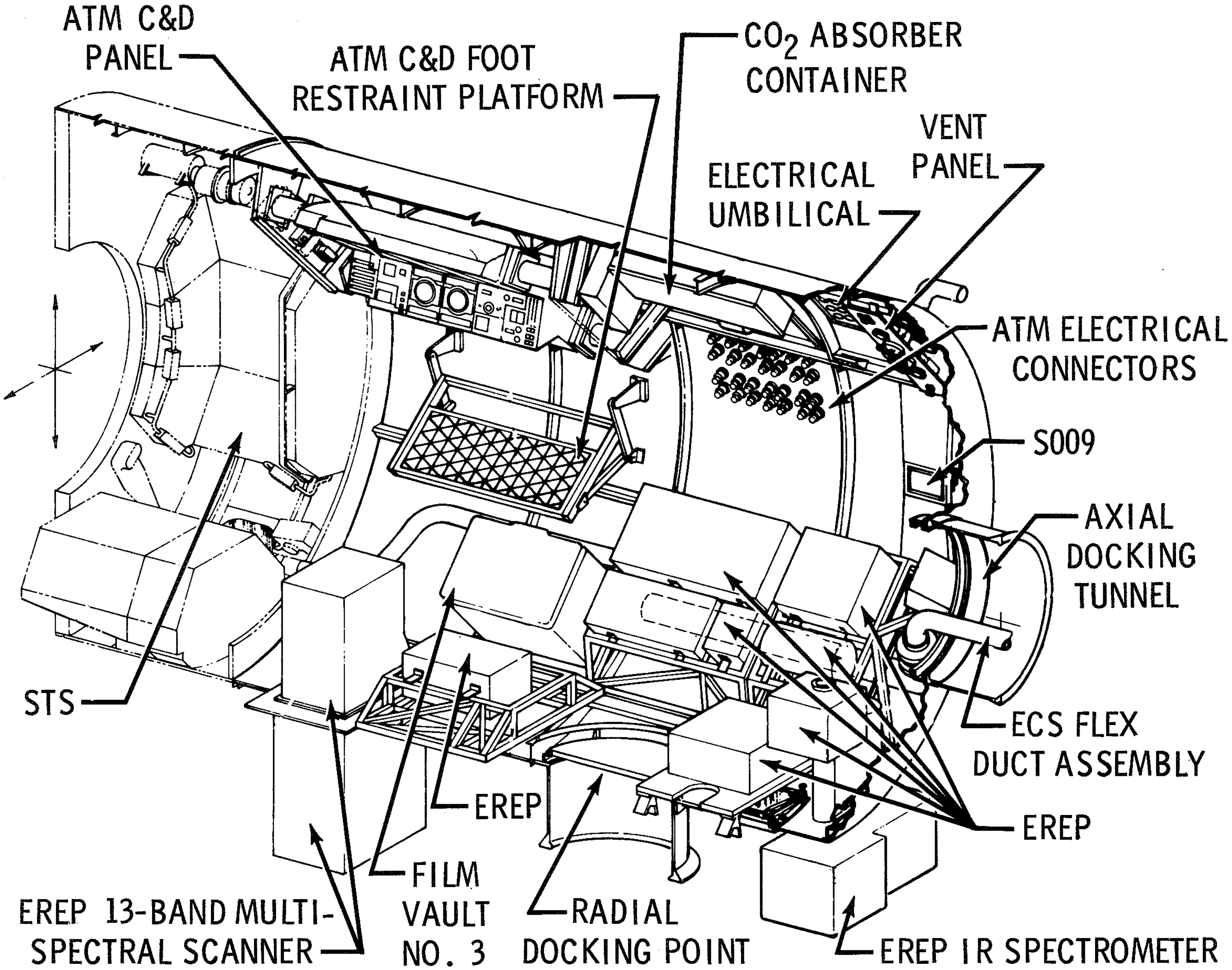
NASA-S-71-12605-V

EXTERNAL STRUCTURE



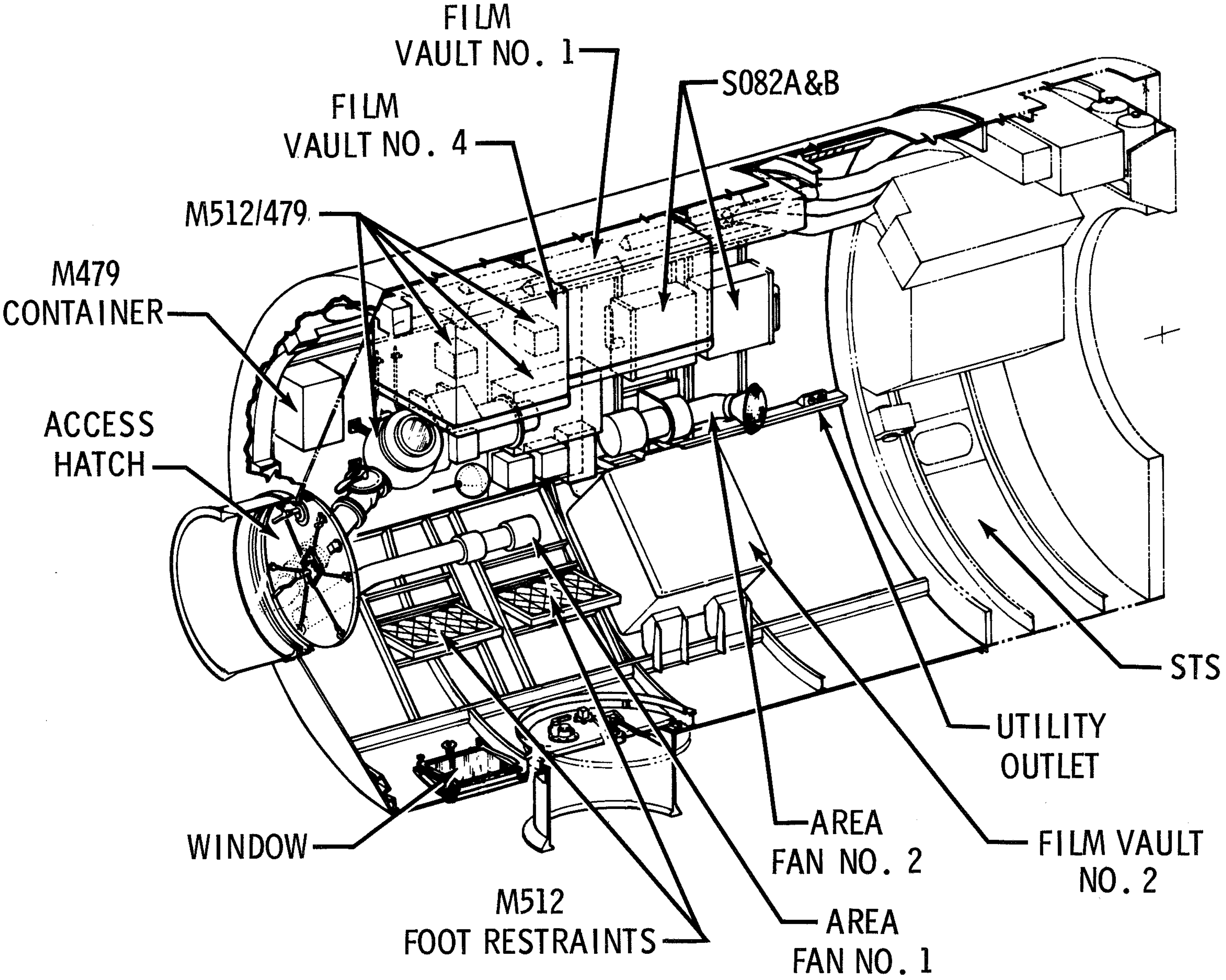
NASA-S-71-12608-V

MDA - INTERNAL ARRANGEMENT



NASA-S-71-12596-V

MDA - INTERNAL ARRANGEMENT



NASA-S-71-12775-V

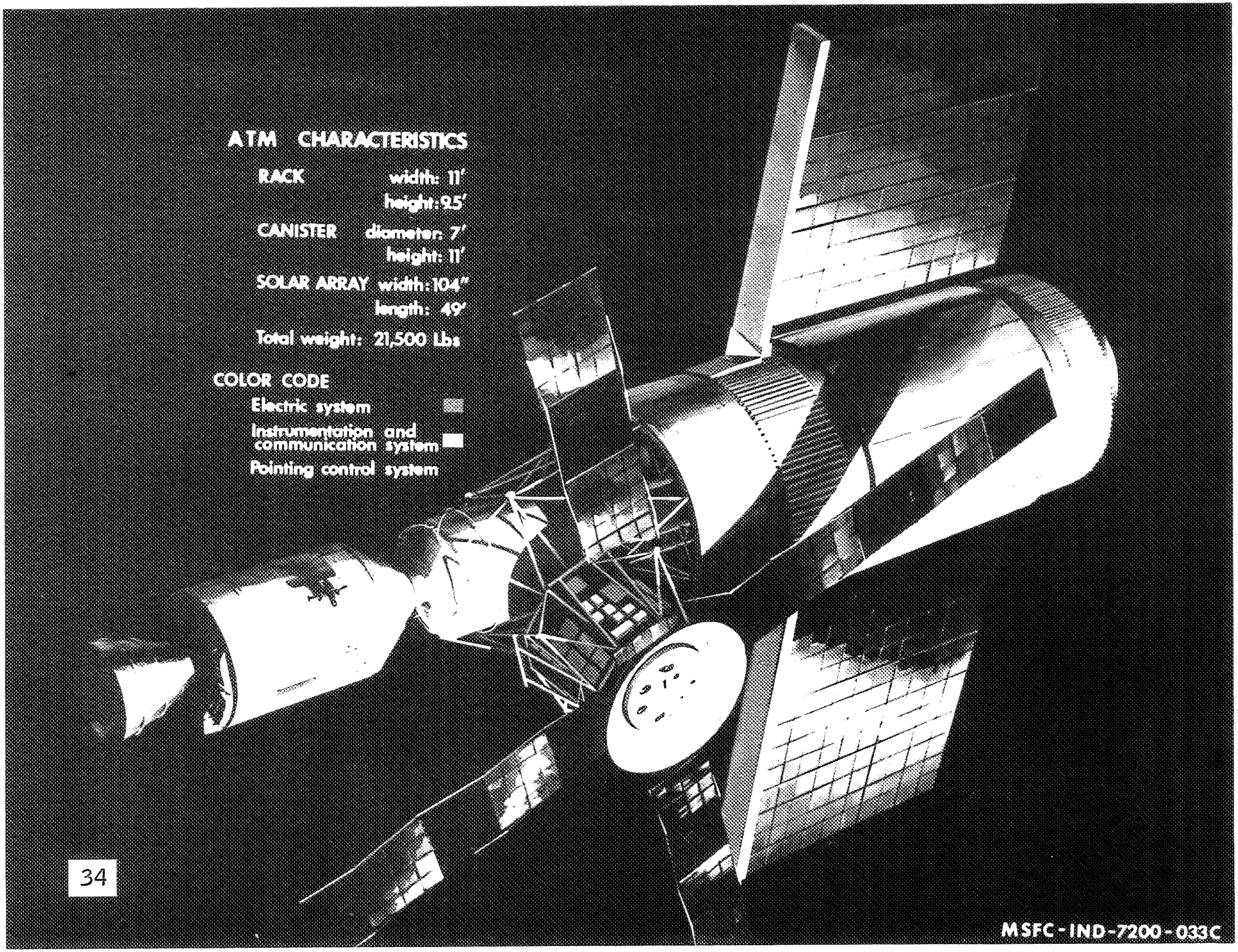
APOLLO TELESCOPE MOUNT (ATM)

Page intentionally left blank

NASA-S-71-12797-V

APOLLO TELESCOPE MOUNT (ATM)

- DESCRIPTION
  - THE ATM IS A SOLAR OBSERVATORY CAPABLE OF OBSERVING, MONITORING, AND RECORDING THE STRUCTURE AND BEHAVIOR OF THE SUN, PARTICULARLY DURING PERIODS OF SOLAR FLARE ACTIVITY
- FUNCTIONS
  - PROVIDES STRUCTURAL SUPPORT FOR CLUSTER ATTITUDE-SENSING, CONTROL, AND EXPERIMENT POINTING
  - PROTECTS AND SUPPORTS SOLAR ASTRONOMY EXPERIMENTS
- DEPLOYMENT ASSEMBLY
  - ALLOWS IN-ORBIT DEPLOYMENT TO A POSITION 90 DEGREES TO THE LONGITUDINAL AXIS OF THE CLUSTER
- RELATED EXPERIMENTS
  - DATA WILL BE TAKEN IN THE WHITE LIGHT, ULTRAVIOLET, AND X-RAY REGIONS OF THE SPECTRUM. OBSERVATIONS WILL BE CONDUCTED BOTH WITHIN AND NEAR THE SOLAR DISC
  - DATA WILL BE RETRIEVED AND FILM WILL BE INSTALLED BY EXTRAVEHICULAR ACTIVITY
- RESPONSIBILITY
  - MARSHALL SPACE FLIGHT CENTER
  - MARTIN MARIETTA CORPORATION
  - BENDIX CORPORATION



ATM CHARACTERISTICS

RACK width: 11′
height: 9.5′

CANISTER diameter: 7′
height: 11′

SOLAR ARRAY width: 104″
length: 49′

Total weight: 21,500 Lbs

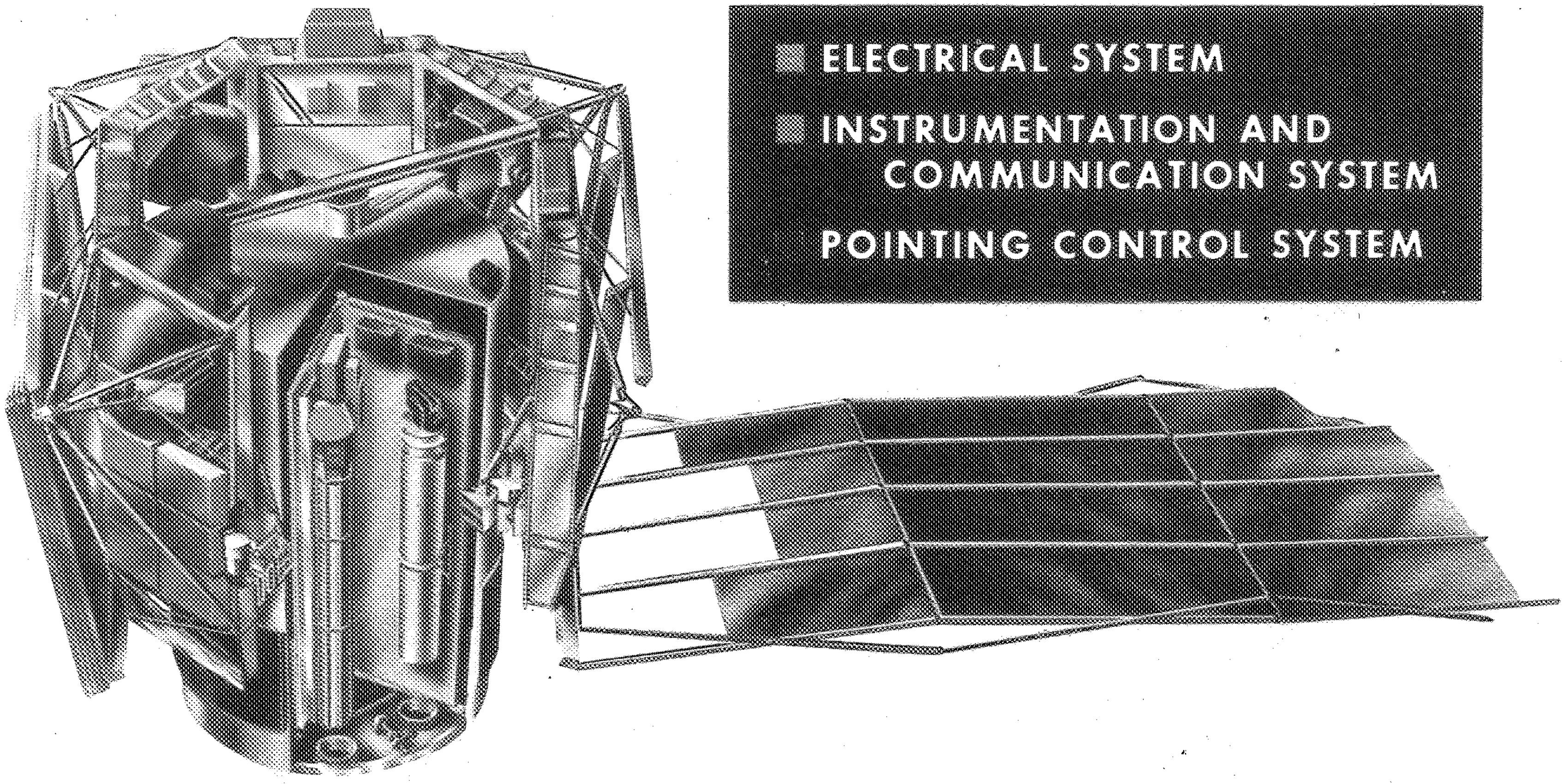
COLOR CODE

Electric system	▨
Instrumentation and communication system	□
Pointing control system	

NASA-S-70-477-S

APOLLO TELESCOPE MOUNT

CANISTER CUT

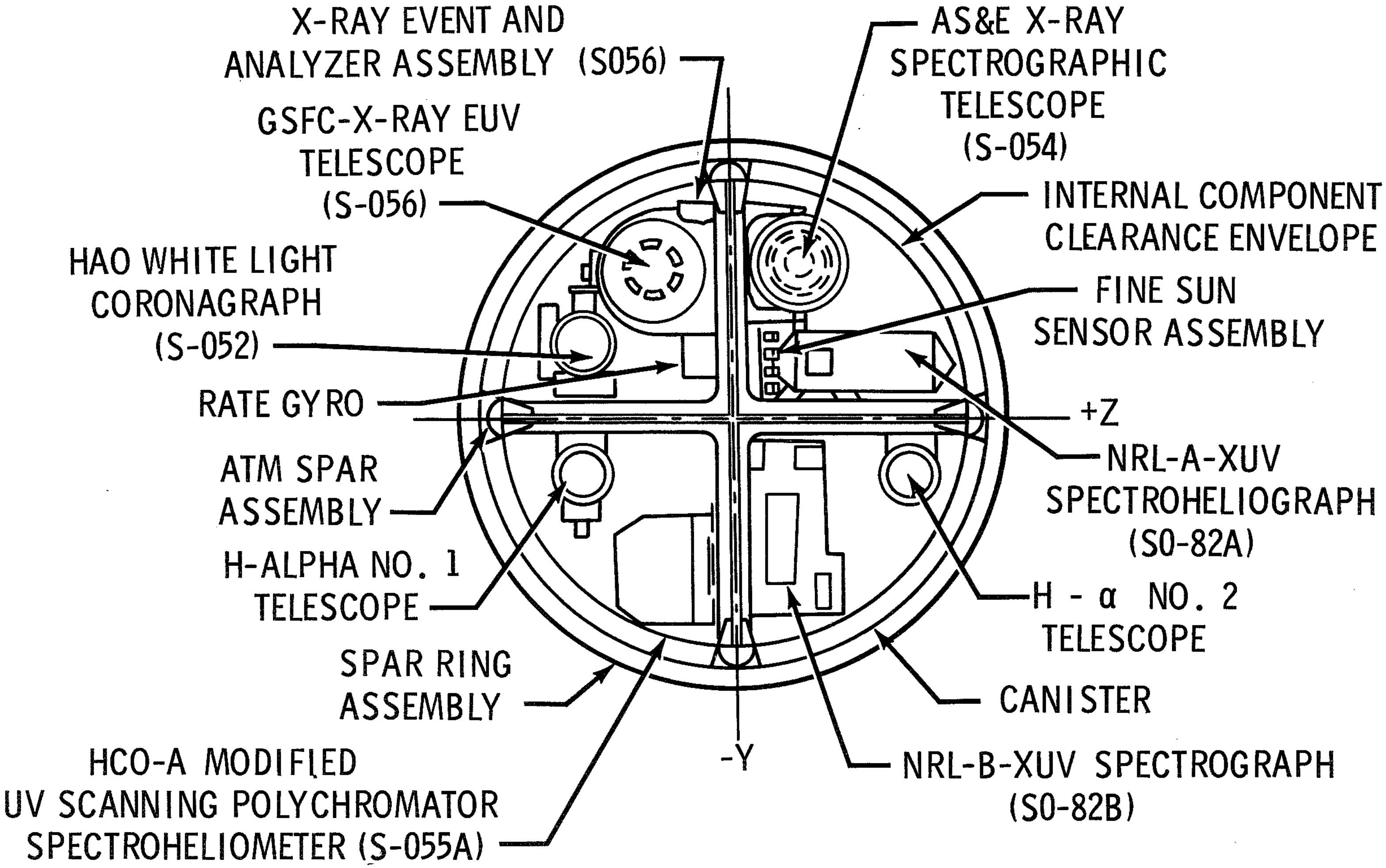


- ▨ ELECTRICAL SYSTEM
- ▨ INSTRUMENTATION AND COMMUNICATION SYSTEM
- POINTING CONTROL SYSTEM

NASA-S-71-12592-V

ATM INTERNAL ARRANGEMENT

ATM EXPERIMENT LAYOUT



NASA-S-71-12792-V

COMMAND AND SERVICE MODULES

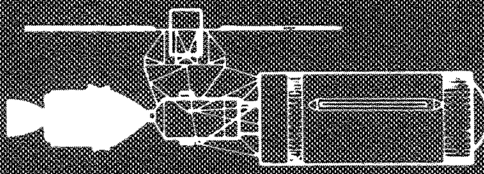
Page intentionally left blank

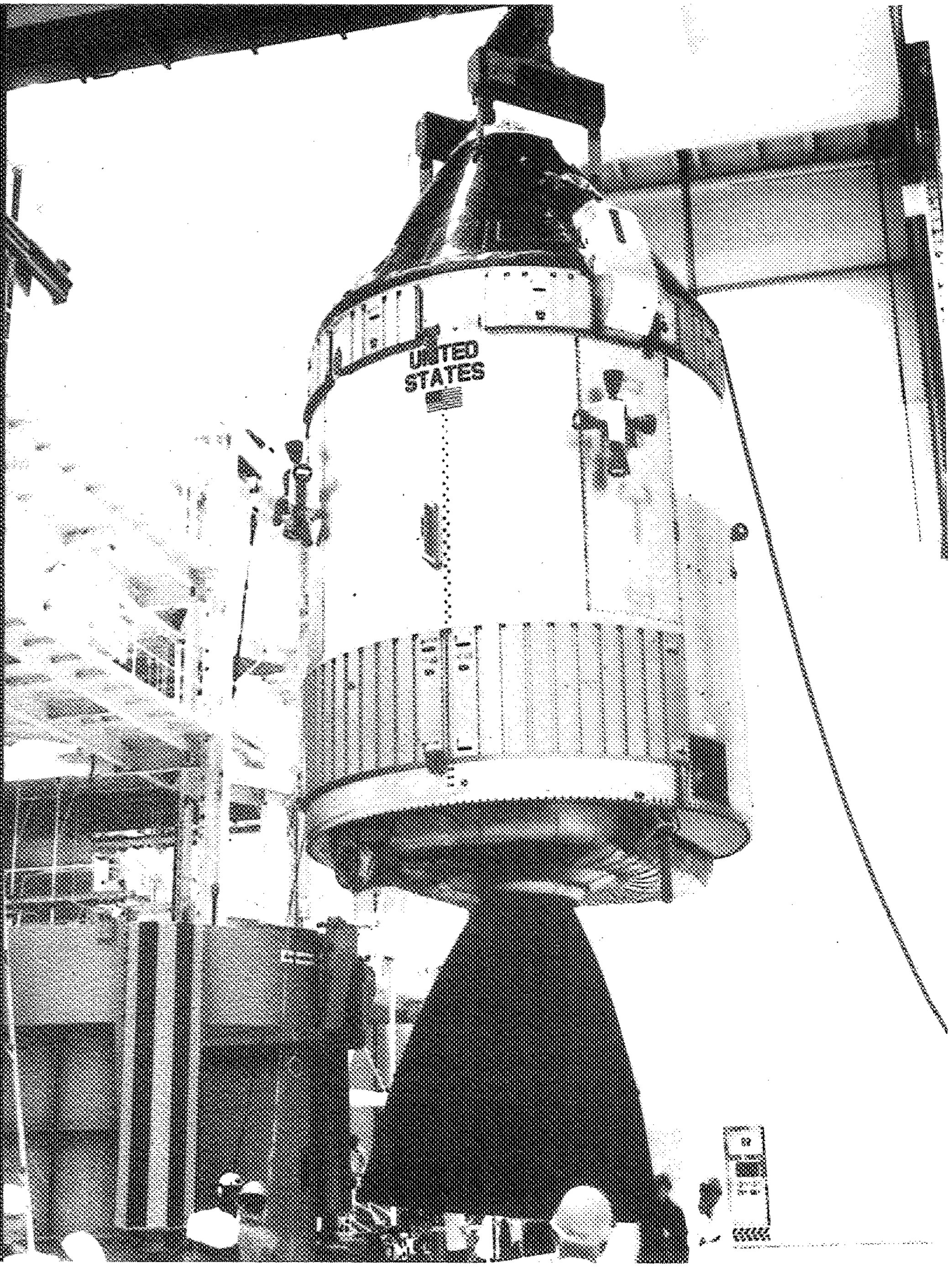
SKYLAB COMMAND AND SERVICE MODULES

- REQUIREMENTS
  - TRANSPORT 3-MAN CREW AND 900 TO 1000 LB OF STOWED EQUIPMENT TO AND FROM WORKSHOP
  - SERVE AS PRIMARY COMMUNICATIONS AND COMMAND STATION
  - PROVIDE ATTITUDE CONTROL OF CLUSTER IF REQUIRED
  - SUPPORT EXPERIMENT ACTIVITIES
  - PROVIDE MINIMAL ELECTRICAL AND THERMAL CONTROL SYSTEMS
  - POSSESS CAPABILITY OF BEING REACTIVATED AFTER 56-DAY SEMIDORMANCY IN SPACE
- MAJOR MODIFICATIONS
  - ADD
    - POWER TRANSFER UMBILICAL
    - INTRAVEHICULAR ACTIVITY STATION
    - ATMOSPHERE INTERCHANGING DUCT
    - HEATERS AND CONTROL WIRING, DESCENT BATTERY PACK
    - BATTERIES
    - PSM
    - RCS
  - REMOVE
    - ONE FUEL CELL
    - ONE He TANK AND SPS STORAGE TANK (BAYS III, VI)

NASA-S-70-3292-X

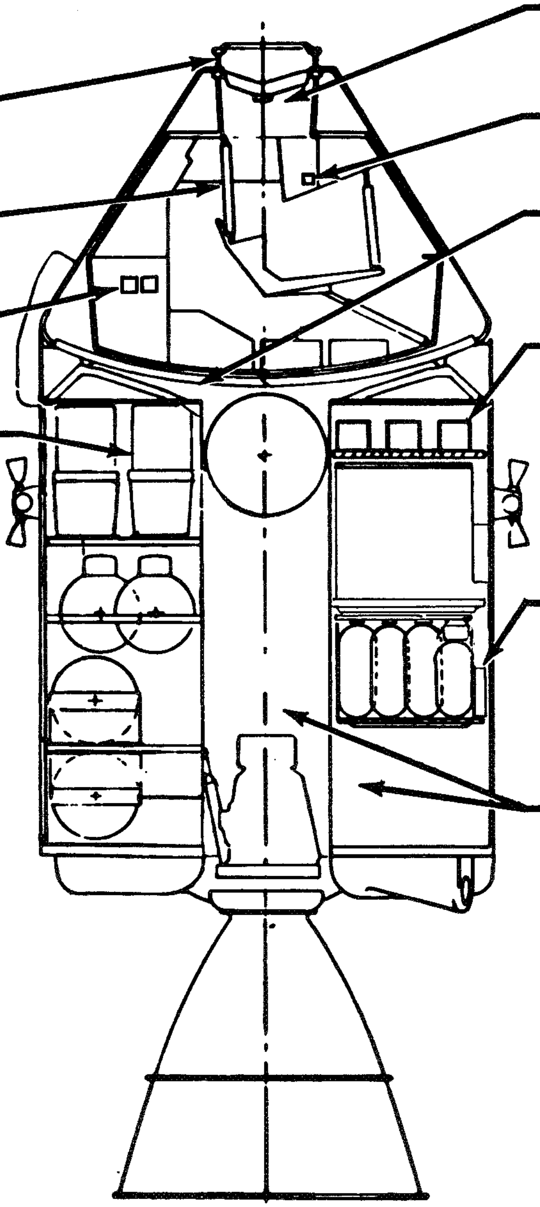
COMMAND AND SERVICE MODULE





NASA-S-71-12785-V

SKYLAB PROGRAM
CSM MODIFICATIONS



- ADD POWER TRANSFER UMBILICAL
- ADD IVA STATION
- 2-40 AH PYRO BATTERIES
- DELETE ONE FUEL CELL
- ADDED HEATERS AND CONTROL WIRING
- ADD ATMOSPHERE INTERCHANGING DUCT
- MODIFIED CAUTION AND WARNING
- RECONFIGURE DC POWER DISTRIBUTION BOX
- ADD DESCENT BATTERY PACK
- ADD RCS SHELF AND COMMON MANIFOLD SYSTEM
- REMOVE ONE He TANK AND SPS STORAGE TANKS (BAYS III, VI)

Page intentionally left blank

NASA-S-71-12622-V

SKYLAB EXPERIMENTS

Page intentionally left blank

NASA-S-71-12784-V

MEDICAL EXPERIMENTS

Page intentionally left blank

NASA-S-71-12597-V

MEDICAL EXPERIMENTS

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT SL-1/SL-2	SL-3	SL-4	OPERATIONAL LOCATION
M072	BONE DENSITOMETRY	MSC	X	X	X	PRE- AND POST FLIGHT
M091	LOWER BODY NEGATIVE PRESSURE	MSC	X	X	X	PRE- AND POST FLIGHT
M111	CYTOGENETIC STUDIES OF BLOOD	MSC	X	X	X	PRE- AND POST FLIGHT
M112	MAN'S IMMUNITY - IN VITRO ASPECTS	MSC	X	X	X	PRE- AND POST FLIGHT
M113	BLOOD VOLUME AND RED CELL LIFE SPAN	MSC	X	X	X	PRE- AND POST FLIGHT
M114	RED BLOOD CELL METABOLISM	MSC	X	X	X	PRE- AND POST FLIGHT
M071	MINERAL BALANCE	MSC	X	X	X	OWS
M073	BIOASSAY OF BODY FLUIDS	MSC	X	X	X	OWS

MEDICAL EXPERIMENTS (CONT)

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT SL-1/SL-2	SL-3	SL-4	OPERATIONAL LOCATION
M074	SPECIMEN MASS MEASUREMENTS	MSC	X	X	X	OWS
M092	INFLIGHT LOWER BODY NEGATIVE PRESSURE	MSC	X	X	X	OWS
M093	VECTORCARDIOGRAM	MSC	X	X	X	OWS
M131	HUMAN VESTIBULAR FUNCTION	MSC	X	X		OWS
M133	SLEEP MONITORING	MSC	X	X	X	OWS
M151	TIME AND MOTION STUDY	MSC	X	X	X	OWS
M171	METABOLIC ACTIVITY	MSC	X	X	X	OWS
M172	BODY MASS MEASUREMENT	MSC	X	X	X	OWS

NASA-S-71-12614-V

MSC SKYLAB EXPERIMENTS

MEDICAL PRE- AND POST FLIGHT

TITLE	PURPOSE
M072 BONE DENSITOMETRY	TO PROVIDE BONE DENSITY DATA THAT WILL, TOGETHER WITH OTHER EXPERIMENTS, ALLOW A DEEPER UNDERSTANDING OF MINERAL METABOLISM DURING SPACEFLIGHT
M091 LOWER BODY NEGATIVE PRESSURE	TO ASSESS THE DECREASE IN THE EFFECTIVENESS OF THE ORTHOSTATIC REFLEX MECHANISMS TO ASSESS CARDIOVASCULAR DECONDITIONING USING PRE- AND POSTFLIGHT DATA AS WELL AS INFLIGHT DATA
M111 CYTOGENETIC STUDIES OF THE BLOOD	TO DETERMINE THE CHROMOSOMAL ABERRATION FREQUENCY IN CREWMEN SUBJECTED TO THE SPACEFLIGHT ENVIRONMENT FOR UP TO 56 DAYS
M112 MAN'S IMMUNITY-IN VITRO ASPECTS	TO ASSAY CHANGES IN CELLULAR AND HUMORAL IMMUNITY INCIDENT TO SPACEFLIGHT
M113 BLOOD VOLUME AND RED CELL LIFE SPAN	TO DETERMINE THE EFFECTS OF PROLONGED ORBITAL MISSIONS ON PLASMA VOLUME, RED CELL PRODUCTION, RED CELL MASS, AND RED CELL SURVIVAL
M114 RED BLOOD CELL METABOLISM	TO DOCUMENT ANY SIGNIFICANT METABOLIC CHANGES WHICH OCCUR IN RED BLOOD CELLS AS A RESULT OF EXPOSURE TO THE SPACEFLIGHT ENVIRONMENT

NASA-S-71-12600-V

MSC SKYLAB EXPERIMENTS

MEDICAL

TITLE	PURPOSE
M071 MINERAL BALANCE	DEFINE AND QUANTITATIVELY ASSESS BODY GAINS AND LOSSES OF BIOCHEMICAL CONSTITUENTS, PARTICULARLY WATER, CALCIUM, AND NITROGEN
M073 BIOASSAY OF FLUIDS	ASSESS THE METABOLIC CHANGES IN MAN AS A RESULT OF THE SPACE ENVIRONMENT
M074 SPECIMEN MASS MEASUREMENT	DEMONSTRATE THE FEASIBILITY OF MASS MEASUREMENT WITHOUT GRAVITY
M092 INFLIGHT LOWER BODY NEGATIVE PRESSURE	EVALUATE SPACEFLIGHT CARDIOVASCULAR DECONDITIONING AND ESTABLISH THE TIME COURSE OF ANY CHANGES
M093 INFLIGHT VECTORCARDIOGRAM	MEASURE ELECTROCARDIOGRAPHIC POTENTIALS DURING WEIGHTLESSNESS AND THE IMMEDIATE POSTFLIGHT PERIOD TO OBTAIN PRECISE MEASUREMENTS OF THE CHANGES THAT OCCUR

MSC SKYLAB EXPERIMENTS (CONT)

MEDICAL

TITLE	PURPOSE
M131 HUMAN VESTIBULAR FUNCTION	DETERMINE THE REQUIREMENT FOR AN ARTIFICIAL GRAVITATIONAL FORCE FOR SPACE FLIGHT AND COMPARE VESTIBULAR RESPONSE IN SPACE WITH PREFLIGHT BASELINE DATA
M133 SLEEP MONITORING	EVALUATE SLEEP QUANTITY AND QUALITY DURING PROLONGED SPACEFLIGHT
M151 TIME AND MOTION STUDY	EVALUATE THE RELATIVE CONSISTENCY BETWEEN GROUND-BASED AND INFLIGHT TASK PERFORMANCE AS CONDUCTED BY ASTRONAUTS AND AS MEASURED BY TIME AND MOTION DETERMINATIONS
M171 METABOLIC ACTIVITY	EVALUATE MAN'S METABOLIC EFFECTIVENESS IN SPACE
M172 BODY MASS MEASUREMENT	VALIDATION OF A MASS MEASURING DEVICE LARGE ENOUGH TO CONTAIN A MAN

Page intentionally left blank

NASA-S-71-12791-V

SCIENTIFIC EXPERIMENTS

Page intentionally left blank

NASA-S-71-13323-V

SCIENTIFIC EXPERIMENTS

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT			OPERATIONAL LOCATION
			SL-1/SL-2	SL-3	SL-4	
S009	NUCLEAR EMULSION	MSFC	X			MDA
S015	EFFECTS OF ZERO GRAVITY ON SINGLE HUMAN CELLS	MSC	X			CM
S019	UV STELLAR ASTRONOMY	MSC	X	X		OWS/SAL
S020	X-RAY/UV SOLAR PHOTOGRAPHY	MSC	X	X		OWS/SAL
S052	WHITE LIGHT CORONAGRAPH	MSFC	X	X	X	MDA/ATM
S054	X-RAY SPECTROGRAPHIC TELESCOPE	MSFC	X	X	X	MDA/ATM
S055A	UV SCANNING POLYCHROMATOR/ SPECTROHELIOMETER	MSFC	X	X	X	MDA/ATM
S056	DUAL X-RAY TELESCOPE	MSFC	X	X	X	MDA/ATM
S063	UV AIRGLOW HORIZON PHOTOGRAPHY	MSC	X	X		OWS/SAL

NASA-S-71-13276-V

SCIENTIFIC EXPERIMENTS (CONT)

EXPT		DEV	MISSION ASSIGNMENT			OPERATIONAL
NO.	EXPERIMENT TITLE	CENTER	SL 1/SL-2	SL-3	SL-4	LOCATION
S071	CIRCADIAN RHYTHM POCKET MICE	ARC		X		SM
S072	CIRCADIAN RHYTHM VINEGAR FLY	ARC		X		SM
S073	GEGENSCHEIN/ZODIACAL LIGHT	MSFC	X	X	X	OWS/SAL
S149	PARTICLE COLLECTION	MSC	X	X	X	OWS/SAL
S150	GALACTIC X-RAY MAPPING	MSFC		X		IU
S183	ULTRAVIOLET PANORAMA	MSFC/FRANCE	X	X	X	OWS/SAL
S082A	XUV CORONAL SPECTROHELIOGRAPH	MSFC	X	X	X	MDA/ATM
S082B	XUV SPECTROGRAPH	MSFC	X	X	X	MDA/ATM
H-ALPHA 1	HCO H-ALPHA TELESCOPE/ CAMERA	MSFC	X	X	X	MDA/ATM
H-ALPHA 2	ATM H-ALPHA TELESCOPE	MSFC	X	X	X	MDA/ATM

NASA-S-71-13324-V

SKYLAB EXPERIMENTS

SCIENTIFIC

TITLE	PURPOSE
S009 NUCLEAR EMULSION	TO STUDY THE CHARGE SPECTRUM OF PRIMARY COSMIC RAYS WITH EMPHASIS ON THE HEAVY NUCLEI (ATOMIC NUMBER, ZZ10)
S015 ZERO-G SINGLE HUMAN CELLS	STUDY THE INFLUENCE OF ZERO GRAVITY ON LIVING HUMAN CELLS AND TISSUE CULTURES
S019 ULTRAVIOLET STELLAR ASTRONOMY	TO OBTAIN A LARGE NUMBER OF STELLAR SPECTRA DOWN TO 1400 ANGSTROMS (UV SPECTRA BEYOND LIMITS OF GROUND-BASED INSTRUMENTS)
	TO OBTAIN SPECTRA OF EARLY-TYPE STARS AND PHOTOGRAPHS OF MILKY WAY FIELDS
S020 UV/X-RAY SOLAR PHOTOGRAPHY	TO PHOTOGRAPH EXTREME UV AND X-RAY EMISSIONS OF THE SUN IN THE 10 TO 200-ANGSTROM WAVE LENGTHS

NASA-S-71-13321-V

SKYLAB EXPERIMENTS (CONT)

SCIENTIFIC

TITLE	PURPOSE
S052 WHITE LIGHT CORONAGRAPH	TO OBSERVE CORONA IN BOTH QUIET AND ACTIVE STATES TO OBSERVE SHORT- AND LONG-TERM VARIATIONS
S054 X-RAY SPECTROGRAPHIC TELESCOPE	TO OBSERVE ACTIVE SOLAR REGIONS IN X-RAY WAVELENGTHS DURING FLARE AND NONFLARE CONDITIONS WITH HIGH SPATIAL, SPECTRAL, AND TEMPORAL RESOLUTION
S055A UV SCANNING POLYCHROMATOR/ SPECTROHELIOMETER	TO RECORD SOLAR SPECTRUM IN 296 TO 1342 Å REGION AND TO STUDY STRUCTURE OF SOLAR ATMOSPHERE
S056 X-RAY TELESCOPE	TO PHOTOGRAPH ACTIVE SOLAR REGIONS IN X-RAY WAVELENGTHS DURING ACTIVE AND QUIET PERIODS WITH HIGH SPATIAL AND TEMPORAL RESOLUTION AND LOW SPECTRAL RESOLUTION
S063 UV AIRGLOW HORIZON PHOTOGRAPHY	TO PHOTOGRAPH THE TWILIGHT AIRGLOW AND EARTH'S OZONE LAYER SIMULTANEOUSLY IN THE VISIBLE AND ULTRAVIOLET WAVELENGTHS
S071/S072 CIRCADIAN RHYTHM (POCKET MICE/VINEGAR GNATS)	TO DETERMINE THE EFFECTS OF WEIGHTLESSNESS ON THE CIRCADIAN RHYTHM OF POCKET MICE AND VINEGAR GNATS

NASA-S-71-13325-V

SKYLAB EXPERIMENTS (CONT)

SCIENTIFIC

TITLE	PURPOSE
S073 GEGENSCHEIN/ZODIACAL LIGHT	TO MEASURE SURFACE BRIGHTNESS AND POLARIZATION OF NIGHT GLOW IN VISIBLE SPECTRUM PERFORM SAME EXPERIMENT WITH SUNLIGHT ON OA TO DETERMINE EXTENT AND NATURE OF OA CORONA
S149 MICROMETEORITE DETECTOR	TO DETERMINE THE MASS DISTRIBUTION OF MICROMETEORITES IN NEAR-EARTH SPACE
S150 GALACTIC X-RAY MAPPING	TO SURVEY SKY FOR X-RAY SOURCES IN 200 TO 12 000 ELECTRON-VOLT RANGE
S183 ULTAVIOLET PANORAMA	TO PHOTOGRAPH STAR FIELDS IN THE VACUUM AND MIDDLE ULTRAVIOLET REGIONS OF THE SPECTRUM
S082A UV CORONAL SPECTROGRAPH	TO RECORD HIGH SPATIAL RESOLUTION IMAGES OF SOLAR DISK IN 150 TO 625 Å RANGE DURING ACTIVE AND QUIET ACTIVITY PERIODS
S082B UV CORONAL SPECTROGRAPH	TO RECORD SOLAR SPECTRUM IN 970 TO 3940 Å REGION
Hα1 HYDROGEN ALPHA TELESCOPE NO. 1	TO ALLOW OBSERVATION OF THE SUN IN THE HYDROGEN ALPHA SPECTRAL LINE (6563A). A VISUAL DISPLAY IS PROVIDED TO THE ASTRONAUT AND A FILM CAMERA RECORD IS OBTAINED THROUGHOUT THE ATM MISSION
Hα2 HYDROGEN ALPHA TELESCOPE NO. 2	TO PROVIDE THE ASTRONAUT WITH A VIDEO DISPLAY OF THE SUN IN Hα LIGHT TO FACILITATE TARGET ACQUISITION AND ATM POINTING

Page intentionally left blank

NASA-S-71-13328-V

ENGINEERING EXPERIMENTS

Page intentionally left blank

NASA-S-71-13322-V

ENGINEERING EXPERIMENTS

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT			OPERATIONAL LOCATION
			SL-1/SL-2	SL-3	SL-4	
M415	THERMAL CONTROL COATINGS	MSFC	X	X		IU/EXT
M479	ZERO GRAVITY FLAMMABILITY	MSFC	X	X	X	MDA
M487	HABITABILITY/CREW QUARTERS	MSFC	X	X	X	OWS
M507	GRAVITY SUBSTITUTE WORKBENCH	MSFC	X	X	X	OWS
M509	ASTRONAUT MANEUVERING EQUIPMENT	MSC	X	X		OWS
M512	MATERIALS PROCESSING IN SPACE	MSFC	X	X		MDA

NASA-S-71-13326-V

SKYLAB EXPERIMENTS

ENGINEERING

TITLE	PURPOSE
M415 THERMAL CONTROL COATINGS	TO DETERMINE THE DEGRADATION EFFECTS OF PRELAUNCH, LAUNCH, AND SPACE ENVIRONMENTS ON THE ABSORPTIVITY/EMISSIVITY AND STABILITY CHARACTERISTICS OF VARIOUS MATERIALS/COATINGS USED FOR PASSIVE THERMAL CONTROL
M479 ZERO GRAVITY FLAMMABILITY	TO IGNITE VARIOUS MATERIALS IN 5 PSIA OXYGEN; DETERMINE SURFACE FLAME PROPAGATION AND FLASHOVER UNDER ZERO-GRAVITY AND ZERO-CONVECTION CONDITIONS; DETERMINE SELF-EXTINGUISHMENT AND EXTINGUISHMENT WITH WATER QUENCH AND WATER SPRAY
M487 HABITABILITY CREW QUARTERS	TO OBTAIN INFORMATION ON THE HABITABILITY ASPECTS OF LIVING QUARTERS AND SYSTEMS IN THE SATURN WORKSHOP AND COMPARE WITH THE VOLUME AND CREW APPOINTMENTS OF PREVIOUS SPACECRAFT
M507 GRAVITY SUBSTITUTE WORKBENCH	TO EXPLORE AND ASSESS THE MERITS OF USING AERODYNAMIC FORCES AS A GRAVITY SUBSTITUTE

NASA-S-71-12616-V

SKYLAB EXPERIMENTS

ENGINEERING

TITLE	PURPOSE
M509 ASTRONAUT MANEUVERING EQUIPMENT	TO OBTAIN ENGINEERING DATA, OPERATIONAL EXPERIENCE AND HUMAN-PERFORMANCE DATA WHILE PERFORMING VARIOUS MANEUVERING TASKS IN A ZERO-GRAVITY ENVIRONMENT WITH A TEST BED MANEUVERING UNIT EMPLOYING SEVERAL CONTROL TECHNIQUES
M512 MATERIALS PROCESSING IN SPACE	TO DEMONSTRATE AND EVALUATE MOLTEN METAL PHENOMENA IN A SPACE ENVIRONMENT; STUDY MOLTEN METAL FLOW, FREEZING PATTERNS, THERMAL STIRRING, AND FUSION ACROSS GAPS IN ZERO-GRAVITY ENVIRONMENT; GAIN EXPERIENCE IN SPACE WELDING TECHNIQUES FOR APPLICATION TO FUTURE MISSIONS

Page intentionally left blank

NASA-S-71-12621-V

TECHNOLOGY EXPERIMENTS

Page intentionally left blank

NASA-S-71-13239-V

TECHNOLOGY EXPERIMENTS

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT SL-1/SL-2	SL-3	SL-4	OPERATIONAL LOCATION
D008	RADIATION IN SPACECRAFT	MSC/AF	X			CM
D024	THERMAL CONTROL COATINGS	MSFC/AF	X	X		AM/EXT
T002	MANUAL NAVIGATION SIGHTINGS	ARC	X	X	X	MDA
T003	INFLIGHT AEROSOL ANALYSIS	MSFC	X	X	X	OWS/CM
T013	CREW VEHICLE DISTURBANCES	LaRC	X	X	X	OWS
T018	PRECISION OPTICAL TRACKING	MSFC	X	X	X	IU/EXT
T020	FOOT CONTROLLED MANEUVERING UNIT	LaRC	X	X	X	OWS
T025	CORONAGRAPH CONTAMINATION MEASUREMENT	MSC	X	X		OWS/SAL
T027	CONTAMINATION MEASUREMENT	MSFC	X	X		OWS/SAL

NASA-S-71-12612-V

SKYLAB EXPERIMENTS

TECHNOLOGY

TITLE	PURPOSE
D008 RADIATION IN SPACE	TO PROVIDE DIRECT EXPERIMENTAL DATA CORRELATION WITH THEORETICAL COMPUTER CODES, SUCH AS THE SPARES RADIATION CODES AND TO OBTAIN DATA TO INTERPRET THE RADIATION-INDUCED BIOLOGICAL EFFECTS ON MAN
D024 THERMAL CONTROL COATINGS	TO DETERMINE EFFECTS OF NEAR-EARTH SPACE ENVIRONMENTS ON SELECTED THERMAL CONTROL COATINGS; PROVIDE NEW INSIGHTS OF DEGRADATION MECHANICS; PROVIDE CORRELATION DATA FOR EVALUATION OF EARTH-BASED EXPERIMENTATION
T002 MANUAL NAVIGATION SIGHTINGS	TO INVESTIGATE THE EFFECTS OF THE SPACEFLIGHT ENVIRONMENT (INCLUDING LONG MISSION TIME) ON A NAVIGATOR'S ABILITY TO MAKE SPACE-NAVIGATION MEASUREMENTS USING HAND-HELD INSTRUMENTS

NASA-S-71-12613-V

SKYLAB EXPERIMENTS (CONT)

TECHNOLOGY

TITLE	PURPOSE
T003 INFLIGHT AEROSOL ANALYSIS	TO MEASURE AEROSOL PARTICLE CONCENTRATION AND SIZE DISTRIBUTION INSIDE SPACECRAFT AS A FUNCTION OF TIME, AND TO COLLECT THE MEASURED AEROSOL PARTICLES FOR POSTFLIGHT ANALYSIS
T013 CREW VEHICLE DISTURBANCES	TO DETERMINE EFFECTS OF CREW MOTIONS ON THE DYNAMICS OF THE ORBITAL ASSEMBLY
T018 PRECISION OPTICAL TRACKING	TO DETERMINE AND EVALUATE THE DEGRADATION OF ACCURACY OF A COHERENT OPTICAL TRACKING SYSTEM DUE TO SMOKE, ENGINE PLUMES, NOISE, SHOCK, AND WEATHER
T020 FOOT CONTROLLED MANEUVERING UNIT	TO DETERMINE CAPABILITY OF ASTRONAUT TO USE A SIMPLE MANEUVERING DEVICE, AND TO OBTAIN DATA FOR FUTURE DESIGN AND GROUND BASED EVALUATION

NASA-S-71-13238-V

SKYLAB EXPERIMENTS (CONT)

TECHNOLOGY

TITLE	PURPOSE
T025 CORONAGRAPH CONTAMINATION MEASUREMENTS	TO DETERMINE/MONITOR THE PRESENCE OF PARTICULATE MATTER SURROUNDING THE CLUSTER, AND TO PROVIDE MEASUREMENTS OF THE SOLAR F-CORONA
T027 CONTAMINATION MEASUREMENT	TO DETERMINE CHANGE IN OPTICAL PROPERTIES OF OPTICAL SAMPLES DUE TO DEPOSITION OF CONTAMINANTS FOUND ABOUT THE OA, AND TO MEASURE SKY BRIGHTNESS BACKGROUND DUE TO SOLAR ILLUMINATION OF PARTICULATE CONTAMINANTS

NASA-S-71-12623-V

EARTH RESOURCES EXPERIMENTS

Page intentionally left blank

NASA-S-71-13243-X

EARTH SURVEY ACTIVITIES AT MANNED SPACECRAFT CENTER

- AIRCRAFT PROJECT
- MANNED SPACE PROJECTS
- RESEARCH DATA FACILITY
- MAPPING SCIENCE BRANCH
- APPLICATIONS OFFICE

NASA-S-71-13269-S

ELEMENTS OF PROJECTS

- SPACECRAFT
  - GEMINI
  - APOLLO
  - SATURN WORKSHOP
  - SPACE STATION/BASE
- AIRCRAFT
  - P3A
  - C130B
  - RB57F
- REMOTE SENSORS
  - PHOTOGRAPHIC
  - INFRARED
  - PASSIVE MICROWAVE
  - ACTIVE MICROWAVE
- DATA PROCESSING/REDUCTION
  - FILM
  - MAGNETIC TAPE
- DATA ANALYSIS
  - GROUND TRUTH CORRELATION
  - SIGNATURE RECOGNITION
- DATA REPOSITORY
  - RESEARCH DATA FACILITY
- MAPPING SCIENCES BRANCH
  - FILM TECHNIQUES
  - MOSAICS
- APPLICATIONS OFFICE
  - HOUSTON MULTI-DISCIPLINE TEST SITE

NASA-S-71-13253-S

EARTH SURVEY OBJECTIVES

- AGRICULTURE/FORESTRY
  - IMPROVE PLANNING AND MARKETING WITH CURRENT CROP CENSUS AND YIELD ESTIMATES
  - INCREASE YIELD BY DETERMINING SOIL CHARACTERISTICS AND OPTIMIZING WATER MANAGEMENT
  - REDUCE LOSSES BY EARLY IDENTIFICATION OF DISEASE, INFESTATION, ETC
- OCEANOGRAPHY
  - IMPROVE FISHING PRODUCTIVITY BY LOCATING COLD WATER UPWELLINGS, BIOLOGICALLY RICH AREAS, OPTIMUM THERMAL CONDITIONS
  - IMPROVE SHIP ROUTING BY MEASUREMENT OF SEA STATE, DETECTION OF NAVIGATION HAZARDS, AND MONITORING OF SEA ICE
  - IMPROVE DEVELOPMENT OF CONTINENTAL SHELVES BY MAPPING SUBMARINE TOPOGRAPHY AND LOCATING OIL SEEPS

NASA-S-71-13271-S

EARTH SURVEY OBJECTIVES (CONT)

- HYDROLOGY
  - INVENTORY WATER SOURCE (eg, SNOW FIELDS) FOR OPTIMUM WATER MANAGEMENT
  - IDENTIFY NEW SOURCES OF FRESH WATER
  - MONITOR HEALTH AND OTHER CHARACTERISTICS OF LAKES
  - IDENTIFY, MONITOR, AND EVALUATE POLLUTION
  - PREDICT AND ASSESS FLOOD DAMAGE
- GEOLOGY
  - IDENTIFY GEOLOGIC FEATURES RELATED TO MINERAL RESOURCES SUCH AS FAULTS, FOLDS, LATERAL CHANGES IN ROCK BEDS
  - MONITOR DYNAMIC FEATURES SUCH AS VOLCANIC ERUPTIONS, LANDSLIDES, COASTAL AND RIVER SEDIMENTATION CHANGES

NASA-S-71-13272-S

EARTH SURVEY OBJECTIVES (CONT)

- GEOGRAPHY
  - INVENTORY AND CLASSIFY MAN'S ACTIVITIES THROUGH PRODUCTION OF THEMATIC MAPS (eg, LAND USE)
  - UNDERSTAND PHYSICIAL GEOGRAPHY TO IMPROVE RURAL AND URBAN DEVELOPMENT

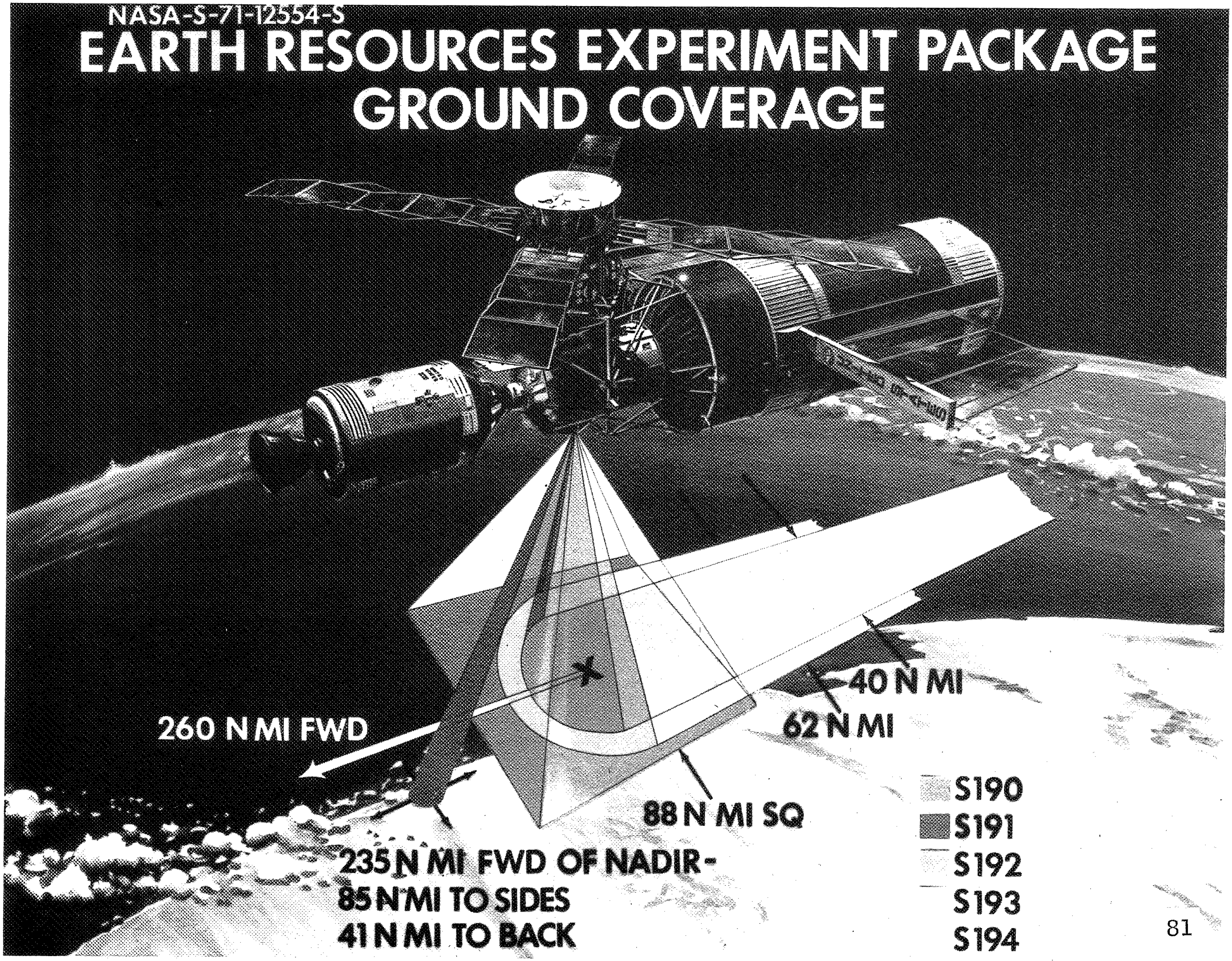
NASA-S-71-12599-V

EARTH RESOURCES EXPERIMENTS

EXPT NO.	EXPERIMENT TITLE	DEV CENTER	MISSION ASSIGNMENT SL-1/SL-2	SL-3	SL-4	OPERATIONAL LOCATION
S190	MULTISPECTRAL PHOTOGRAPHIC FACILITY	MSC	X	X	X	MDA
S191	INFRARED SPECTROMETER	MSC	X	X	X	MDA
S192	13-BAND MULTISPECTRAL SCANNER	MSC	X	X	X	MDA
S193	MICROWAVE RADIOMETER/ SCATTEROMETER AND ALTIMETER	MSC	X	X	X	AM/EXT
S194	L-BAND RADIOMETER	MSC	X	X	X	MDA/EXT

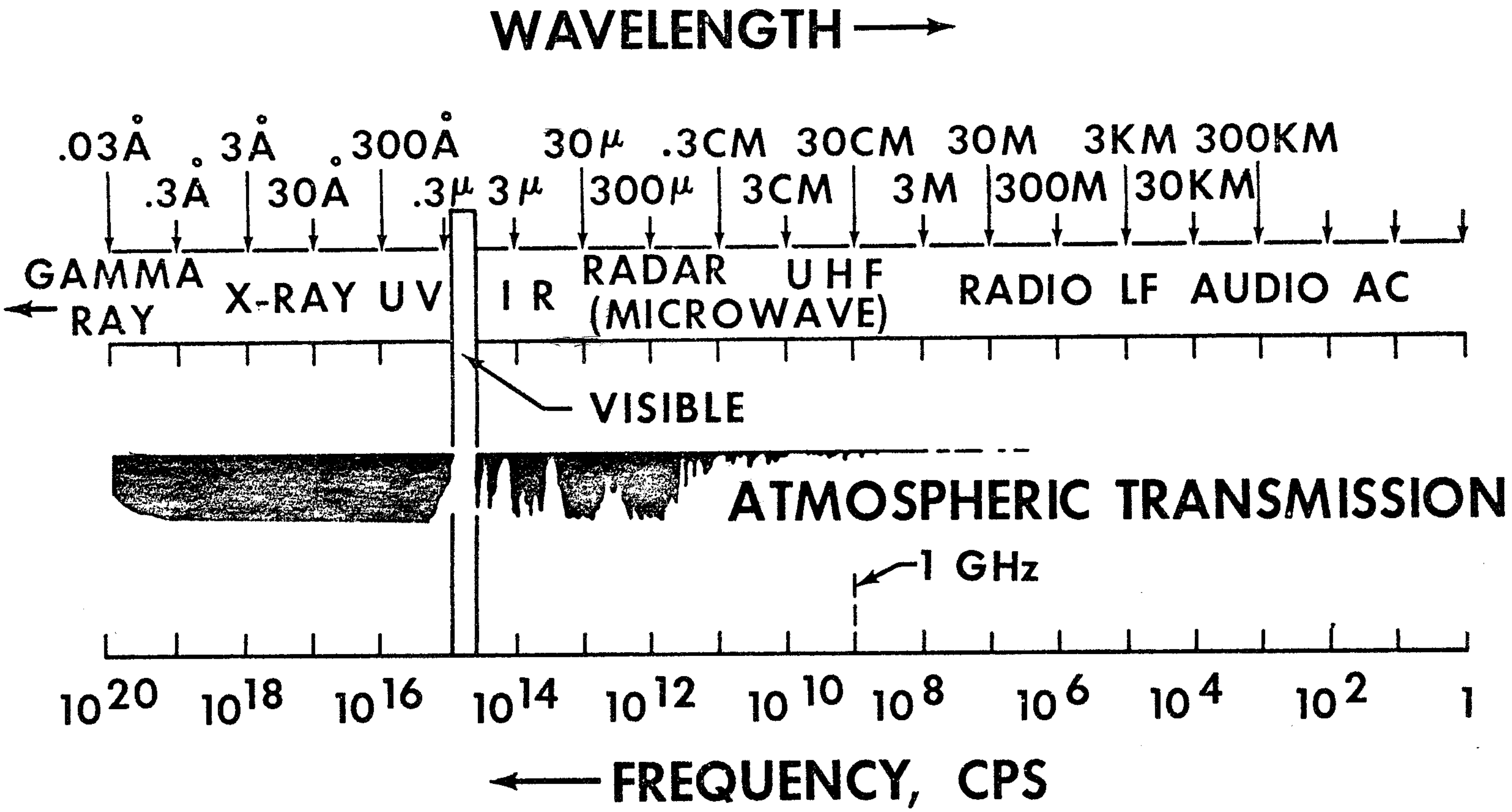
NASA-S-71-12554-S

EARTH RESOURCES EXPERIMENT PACKAGE GROUND COVERAGE



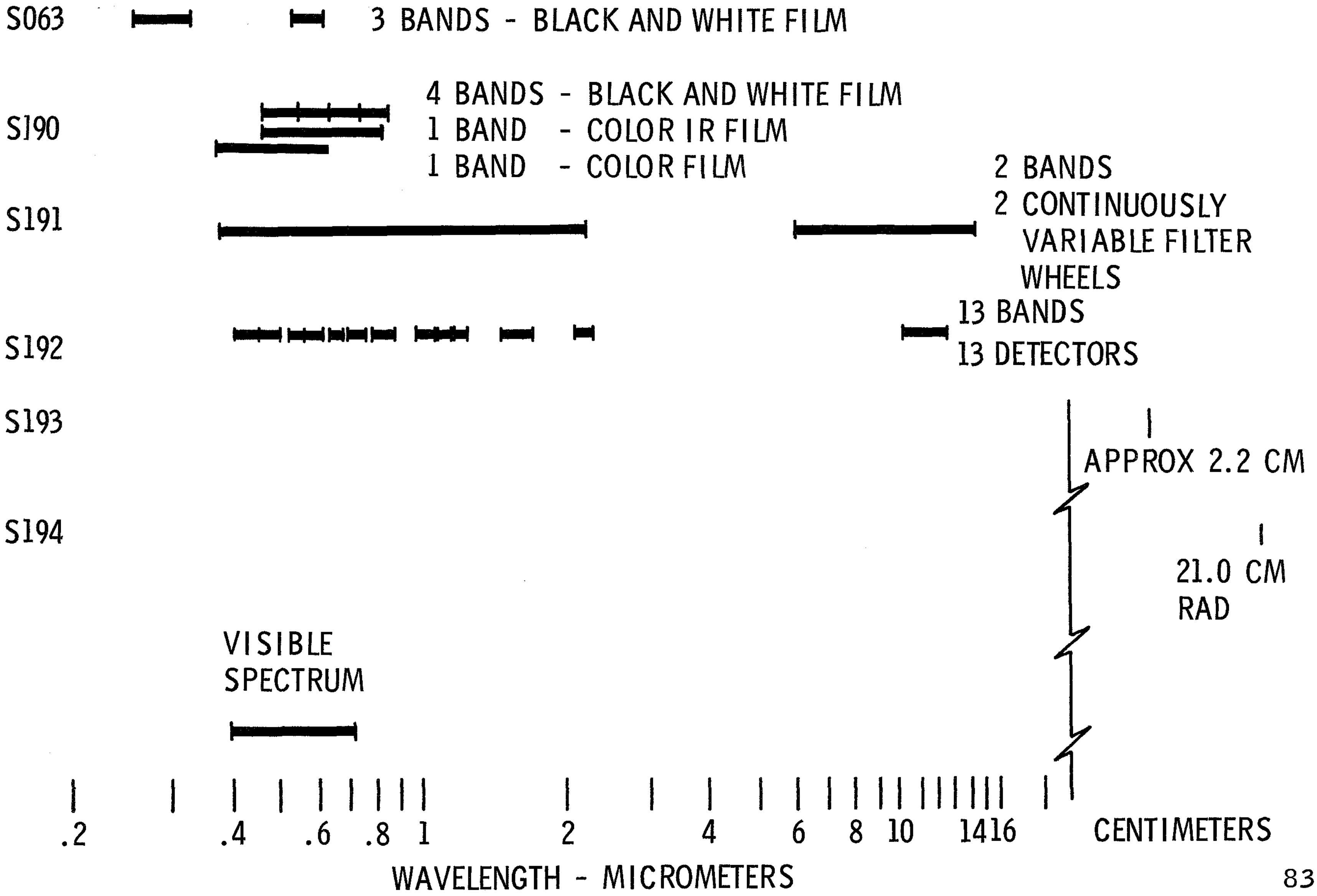
NASA-S-69-3048

CHARACTERISTICS OF THE ELECTROMAGNETIC SPECTRUM WHICH ARE OF SIGNIFICANCE IN REMOTE EXPLORATION



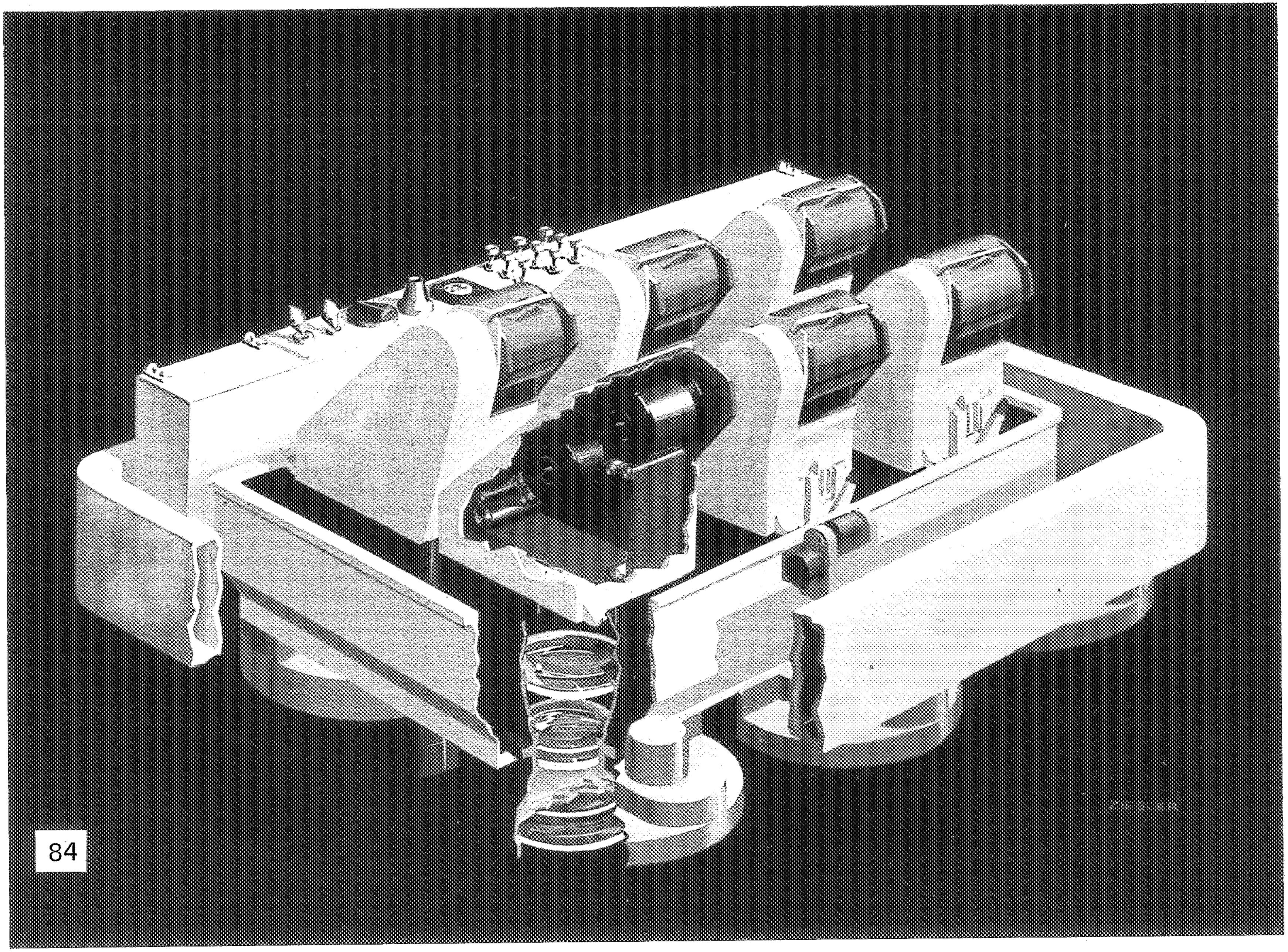
NASA-S-71-12604-V

WAVELENGTH SENSITIVITY OF EARTH VIEWING SKYLAB SENSORS



NASA-S-71-13168-V

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
S190 CAMERA CUTAWAY



NASA-S-71-13262-V

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

- DESCRIPTION
  - 6-CHANNEL CAMERA SYSTEM WITH FORWARD MOTION COMPENSATION
  - MEASURES ENERGY (IN THE VISIBLE AND INFRARED REGIONS) EMITTED OR REFLECTED FROM EARTH FEATURES
- OBJECTIVE
  - PROVIDE PHOTOGRAPHIC FACILITY TO ALLOW STUDIES OF THE VALUE OF MULTISPECTRAL PHOTOGRAPHY USING VARIOUS FILM/FILTER COMBINATIONS FOR THE IDENTIFICATION AND ASSESSMENT OF EARTH, OCEAN, AND CLOUD FEATURES
  - PROVIDE HIGH-QUALITY MULTISPECTRAL PHOTOGRAPHY
  - DETERMINE EXTENT MULTISPECTRAL PHOTOGRAPHY CAN BE APPLIED TO DETAILED ANALYSIS IN EARTH RESOURCES
- PHYSICAL CHARACTERISTICS OF PHOTOGRAPHIC ASSEMBLY
  - DIMENSIONS: 22.5 BY 24 BY 18 IN.
  - VOLUME: 5.63 CU FT
  - WEIGHT: 296 LB
  - POWER: 28 V DC, 22 AMPS PEAK

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
EXPERIMENT CONCEPT

- MAXIMUM FLEXIBILITY TO SUPPORT WIDE RANGE OF DISCIPLINES AND INVESTIGATORS
  - SIX CHANNELS
    - FOUR B&W
    - TWO COLOR
  - FILM FLEXIBILITY (THREE MAGAZINE SETS)
  - FILTER FLEXIBILITY (12 ADDITIONAL FILTERS)

NASA-S-71-13153-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

SPECIFICATIONS

- LENSES
  - 6-INCH FOCAL LENGTH 150 MM
  - f/2.8 APERTURE
- FILM
  - 70 mm
  - 400 FRAMES/CASSETTE
  - 2.5 OR 4 MIL BASE 0.06 or 0.10 MM
- FORMAT
  - 2-1/4 × 2-1/4 INCHES 57 x 57 MM
- APERTURE STOPS
  - f/2.8 TO f/16 IN 1/2 STOP INCREMENTS (ACCURACY ±1.5 PERCENT)
- SHUTTER SPEED
  - 2.5, 5, AND 10 MILLISECONDS (REPEATABILITY OF 2.5 PERCENT)
  - 75 PERCENT EFFICIENCY
  - 4-MILLISECOND SYNCHRONIZATION
- FMC
  - 10 TO 30 MILLIRADIANS/SEC (ACCURACY 5 PERCENT)

NASA-S-71-13297-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

SPECIFICATIONS (CONT)

- BORESIGHTING
  - 60 ARC SECONDS
- SEQUENCE RATE
  - ONE FRAME EVERY 2 SEC TO ONE FRAME EVERY 20 SEC
- DISTORTION MATCH (DYNAMIC)
  - 7.5 × 28 TAN θ MICROMETERS FOR CHANNELS 1 THROUGH 4
  - 12 × 28 TAN θ MICROMETERS FOR CHANNELS 1 THROUGH 6
- DESIGN WAVELENGTHS/FILM TYPES

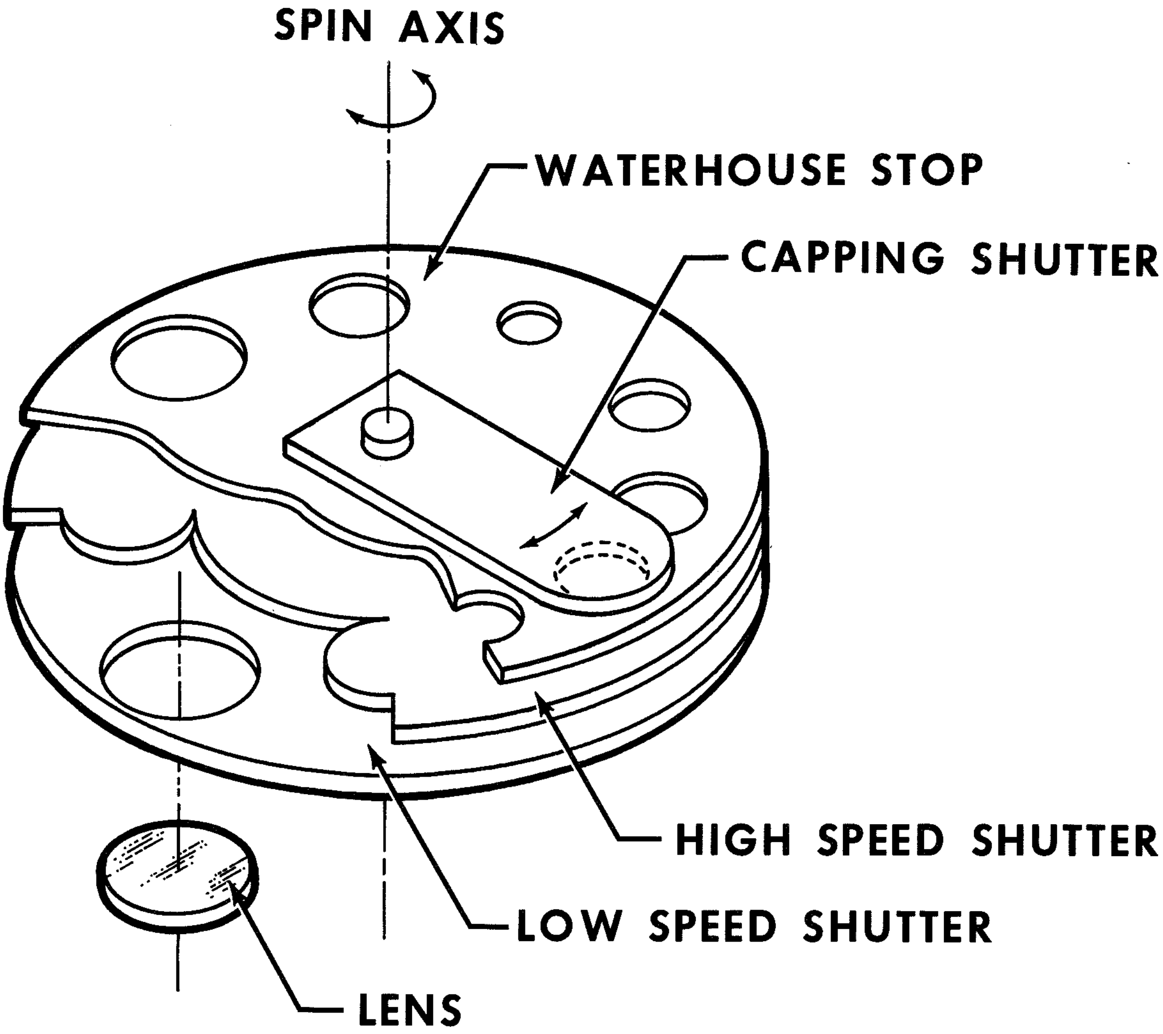
CAMERA	WAVELENGTH	FILM
1	.5 - .6	PAN X
2	.6 - .7	PAN X
3	.7 - .8	B&W IR
4	.8 - .9	B&W IR
5	.5 - .88	COLOR IR
6	.4 - .7	AERIAL COLOR

NASA-S-71-13311-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

SHUTTER ASSEMBLY

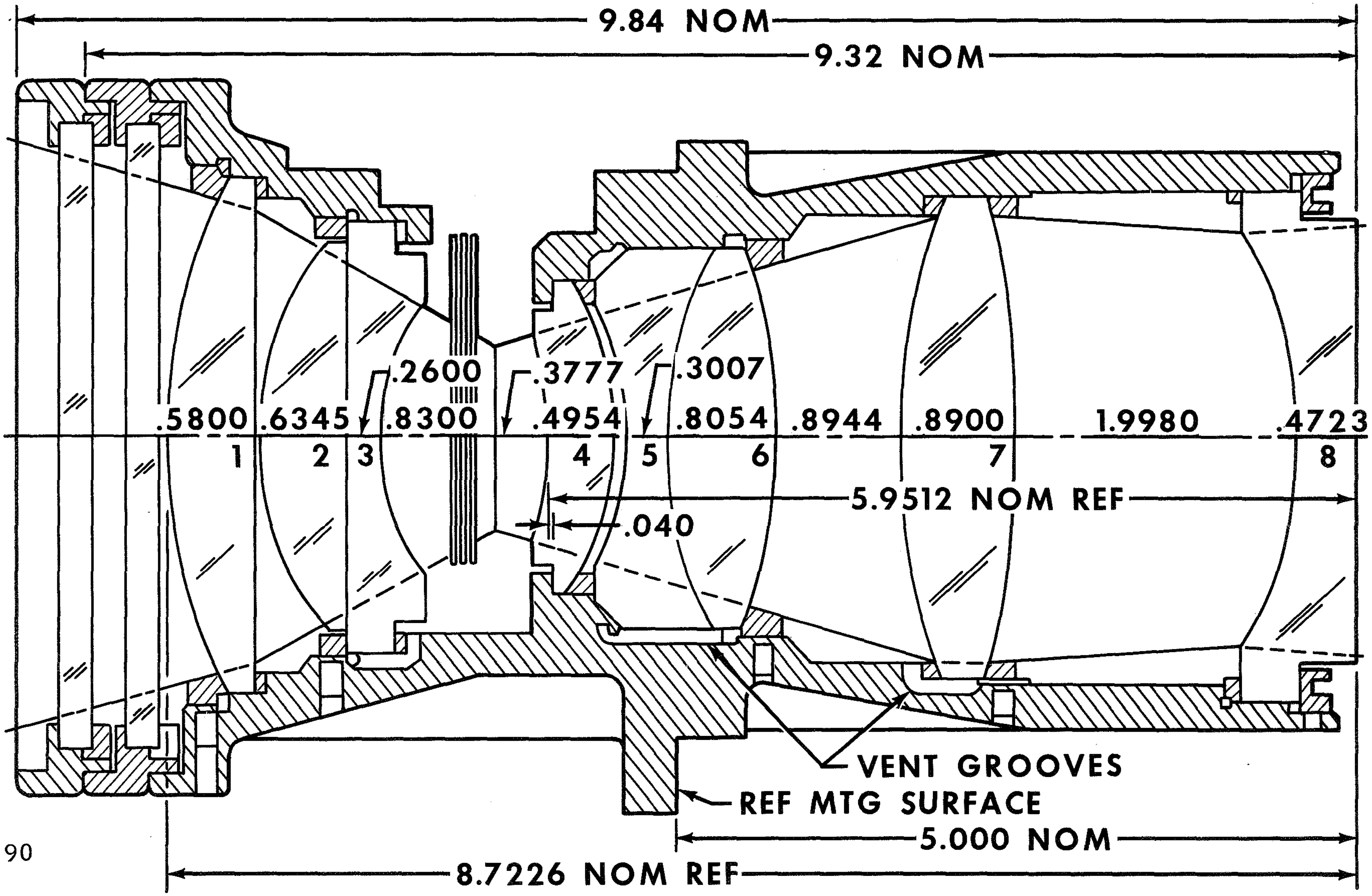
TOTAL STOPS: 11



NASA-S-71-13300-S

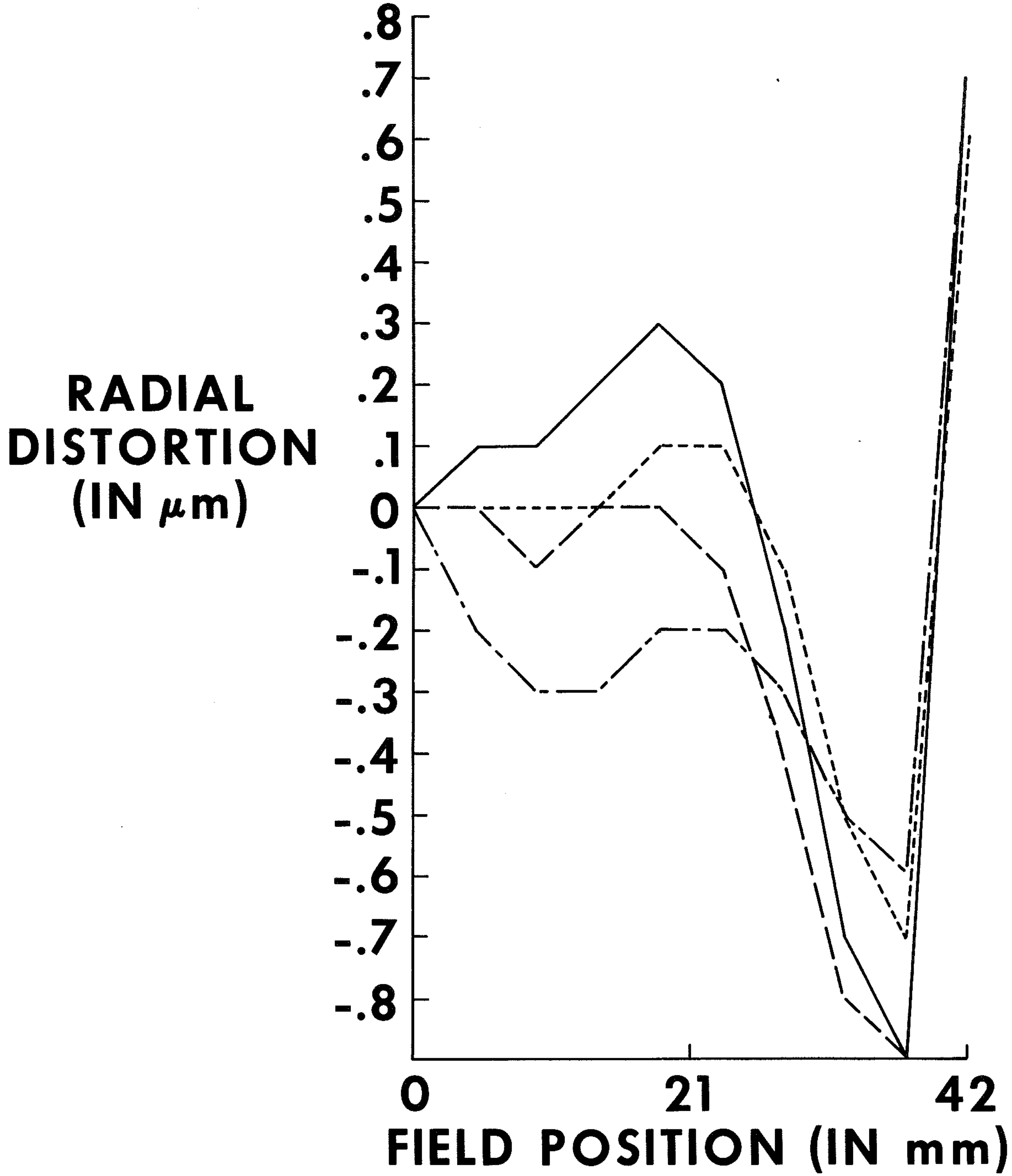
S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

6 INCH FL f/2.8 S190 LENS



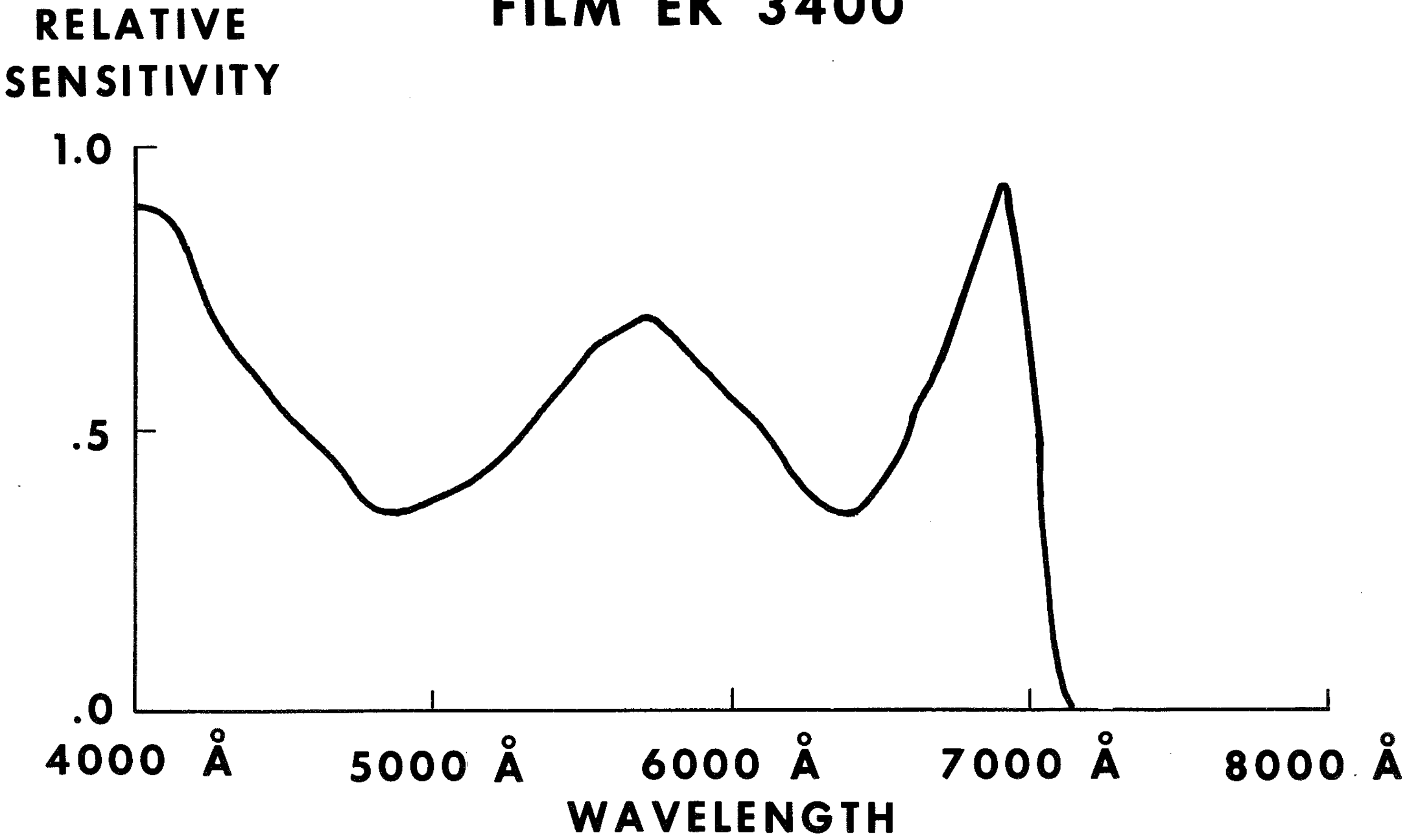
NASA-S-71-13167-X

S190 MULTISPECTRAL PHOTOGRAGHIC FACILITY RADIAL DISTORTION CURVES FOR LENSES DESIGNED FOR USE WITH EK 3400 AND EK 2424



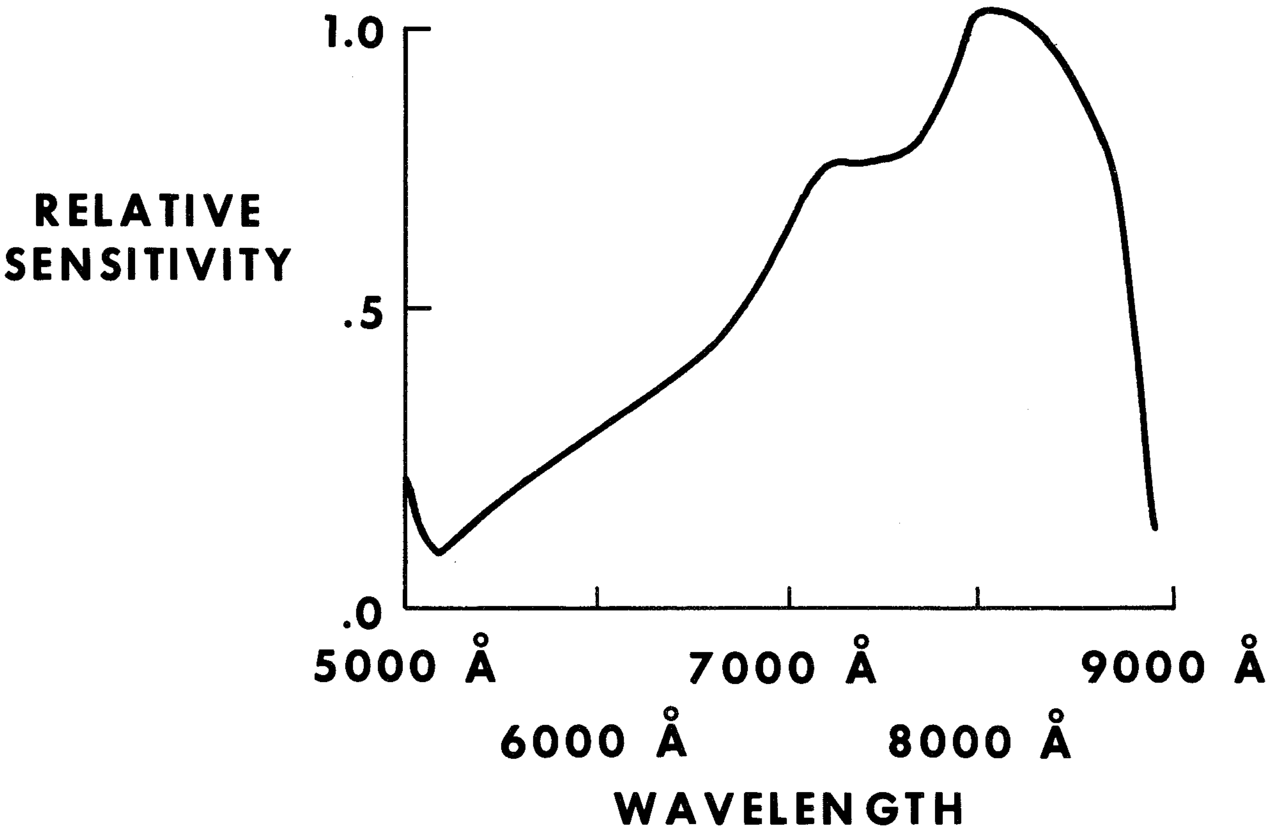
NASA-S-71-13186-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
FILM EK 3400



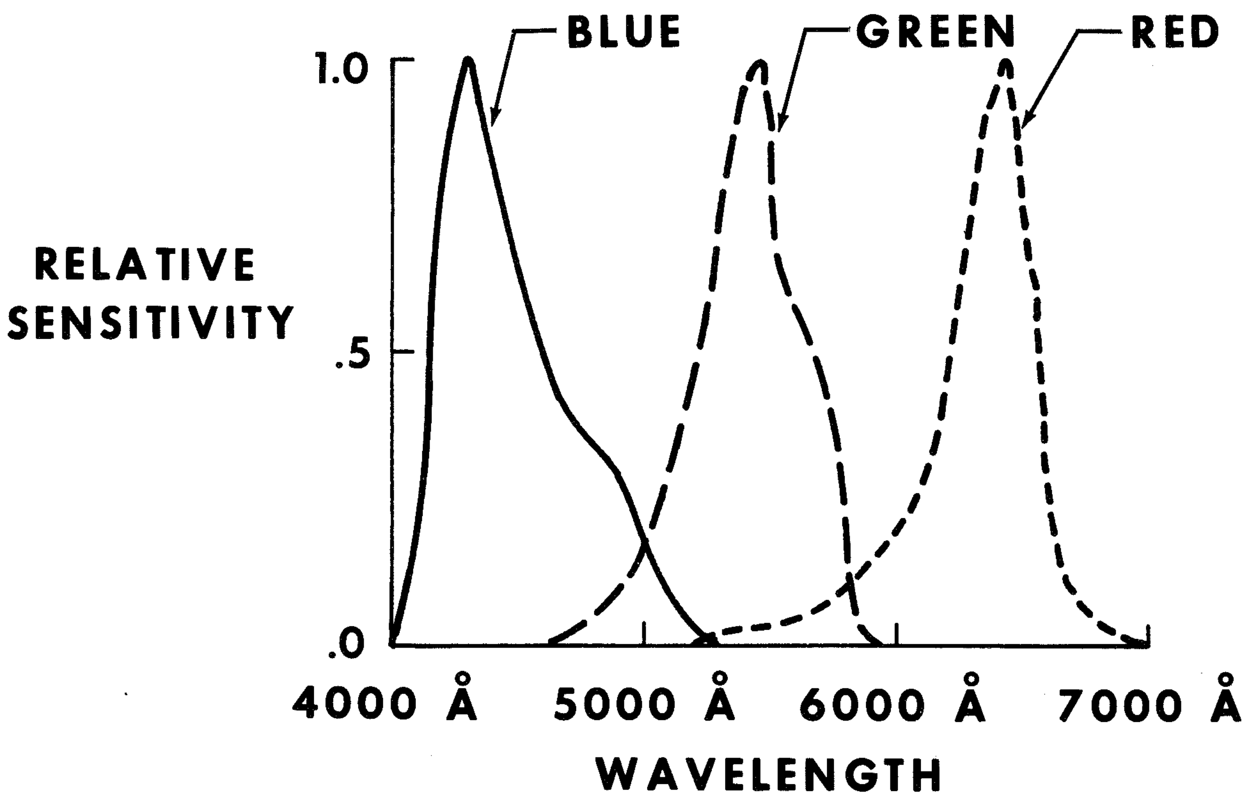
NASA-S-71-13187-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
FILM EK 2424



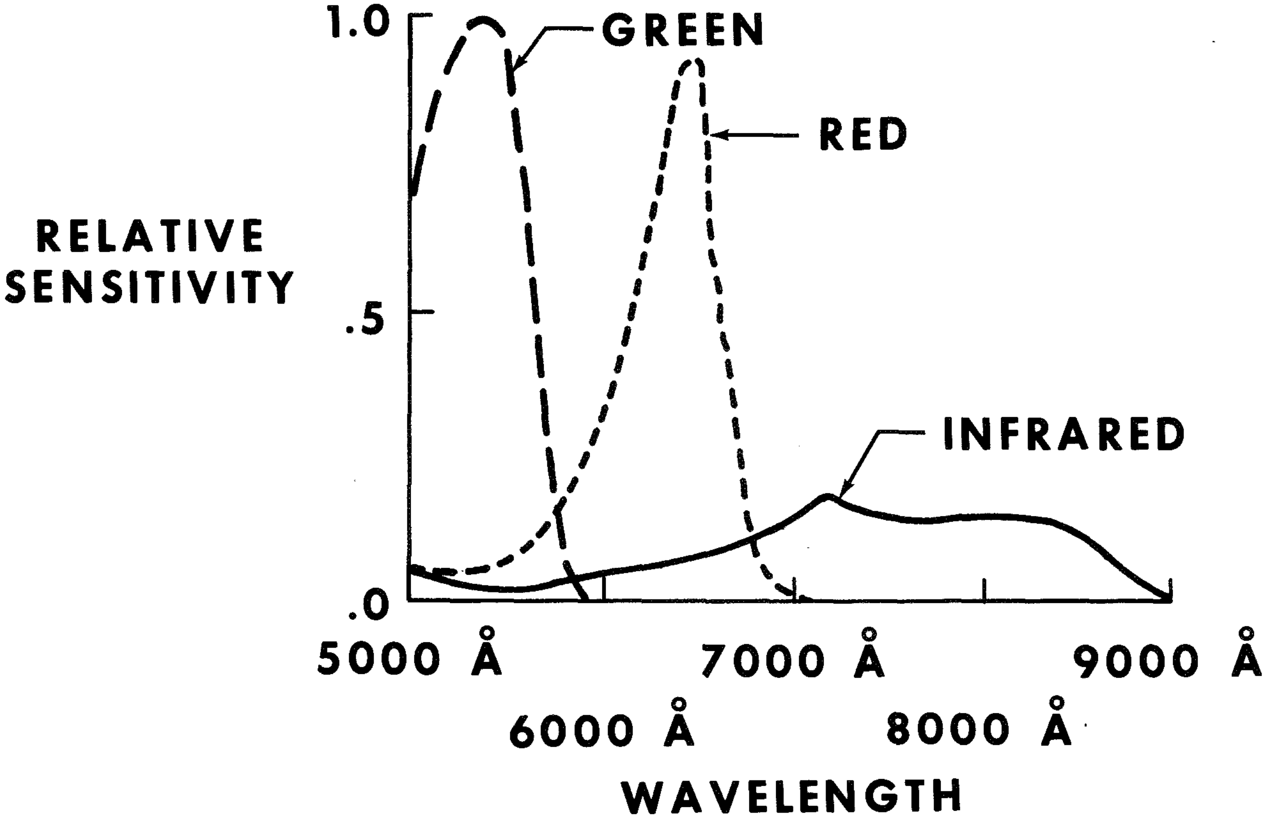
NASA-S-71-13252-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY FILM S0242



NASA-S-71-13251-X

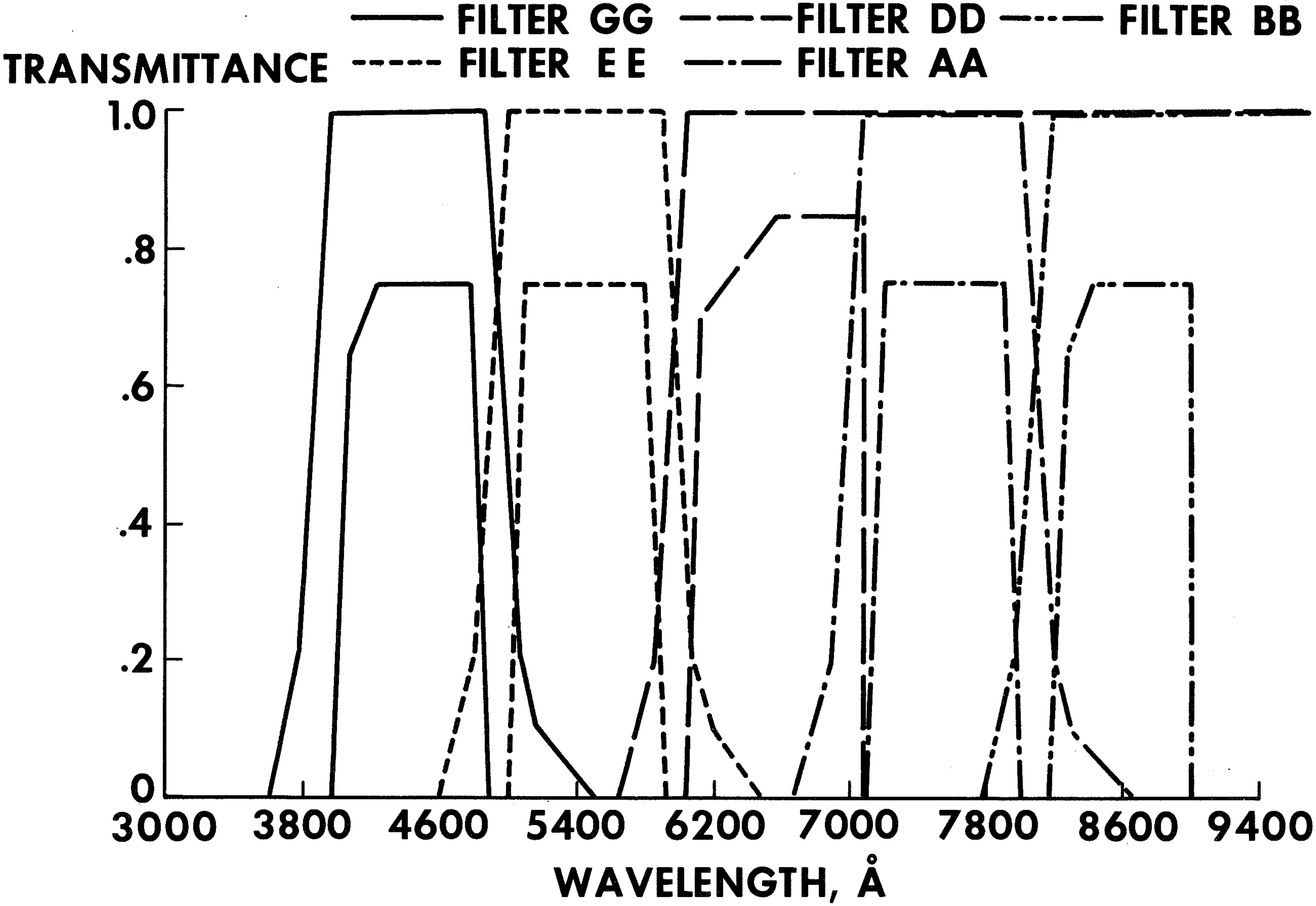
S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
FILM EK 3443



NASA-S-71-13305-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

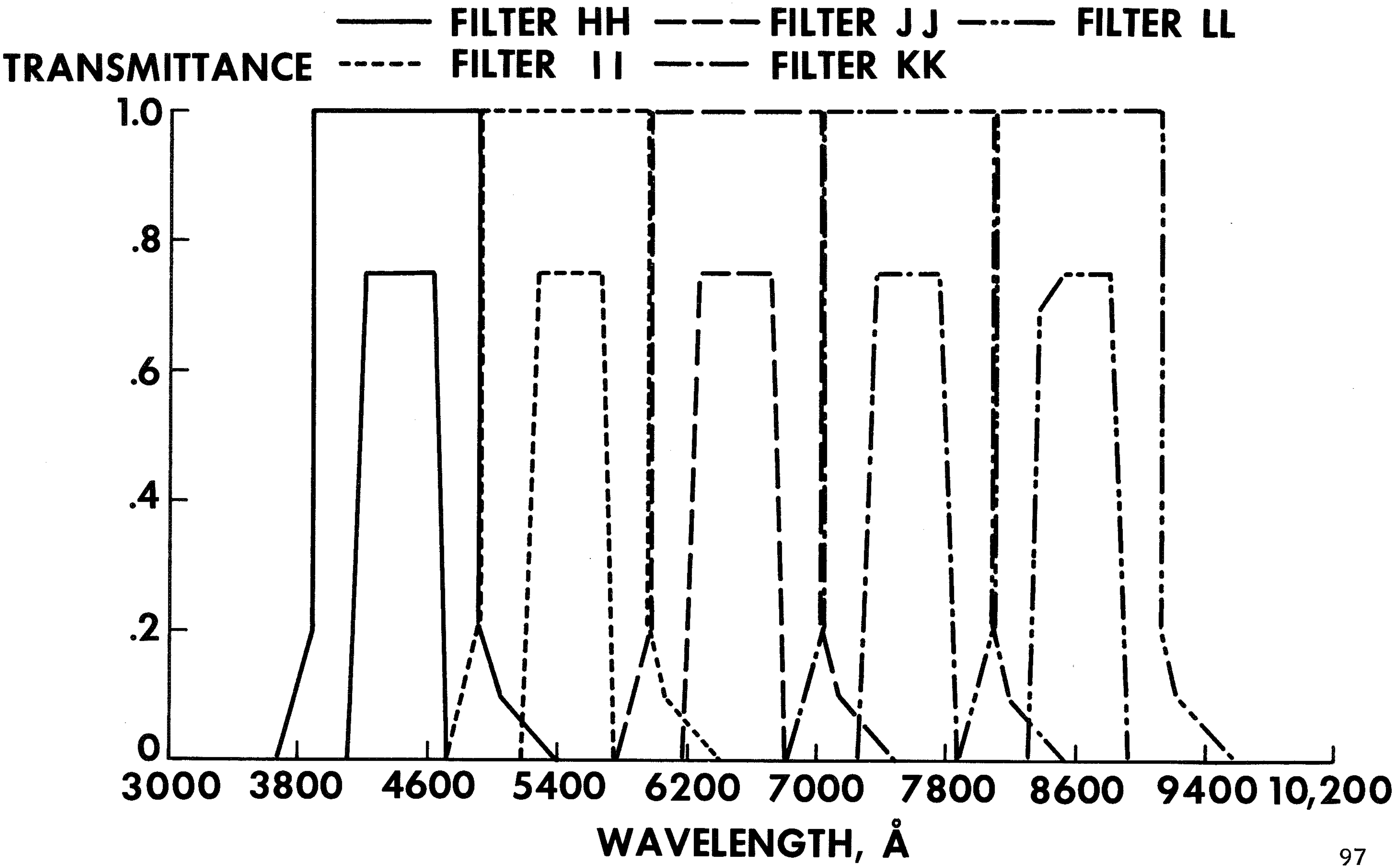
TRANSMISSION ENVELOPES FOR FILTERS



NASA-S-71-13306-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

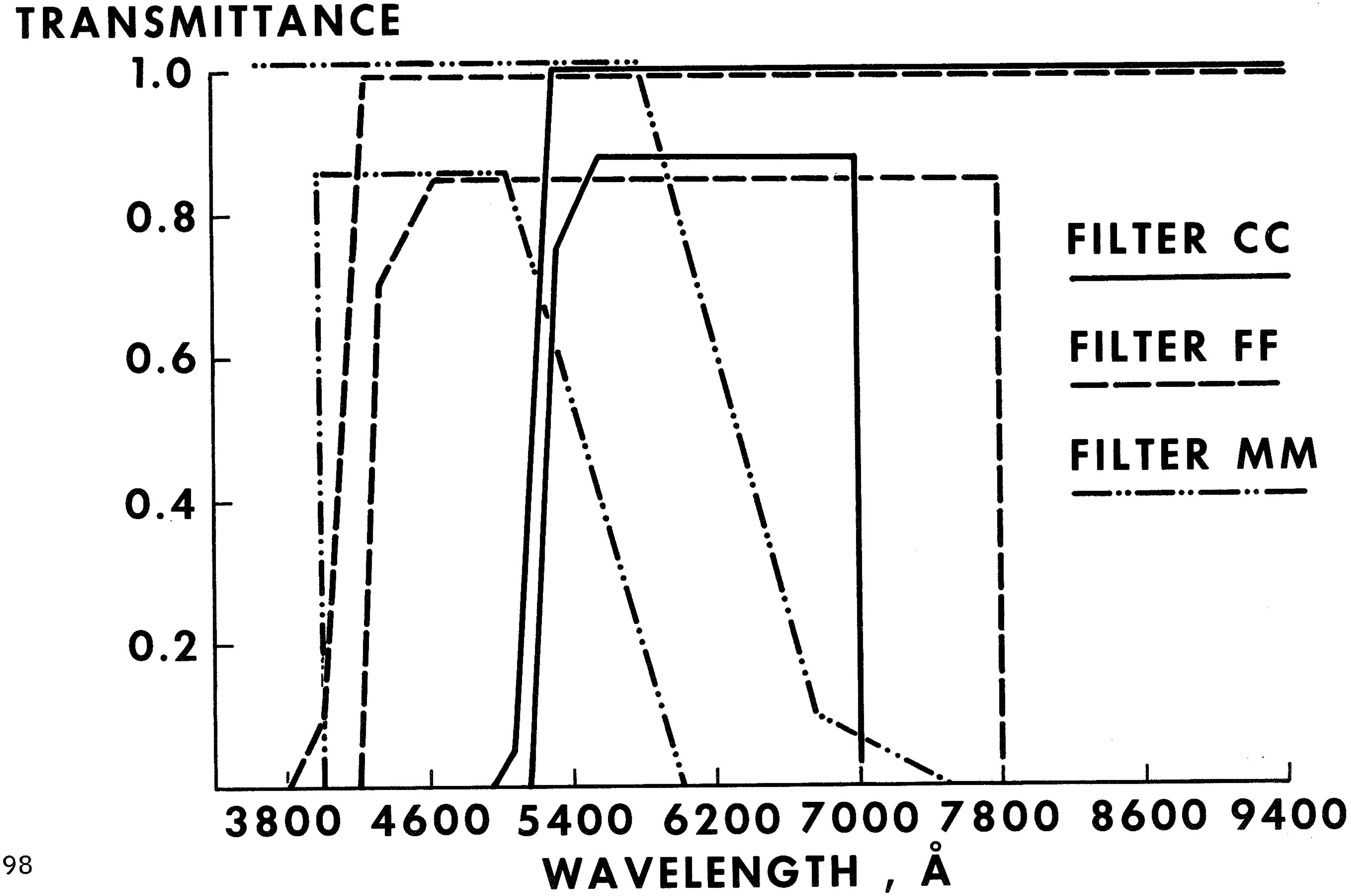
TRANSMISSION ENVELOPES FOR FILTERS



NASA-S-71-13310-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

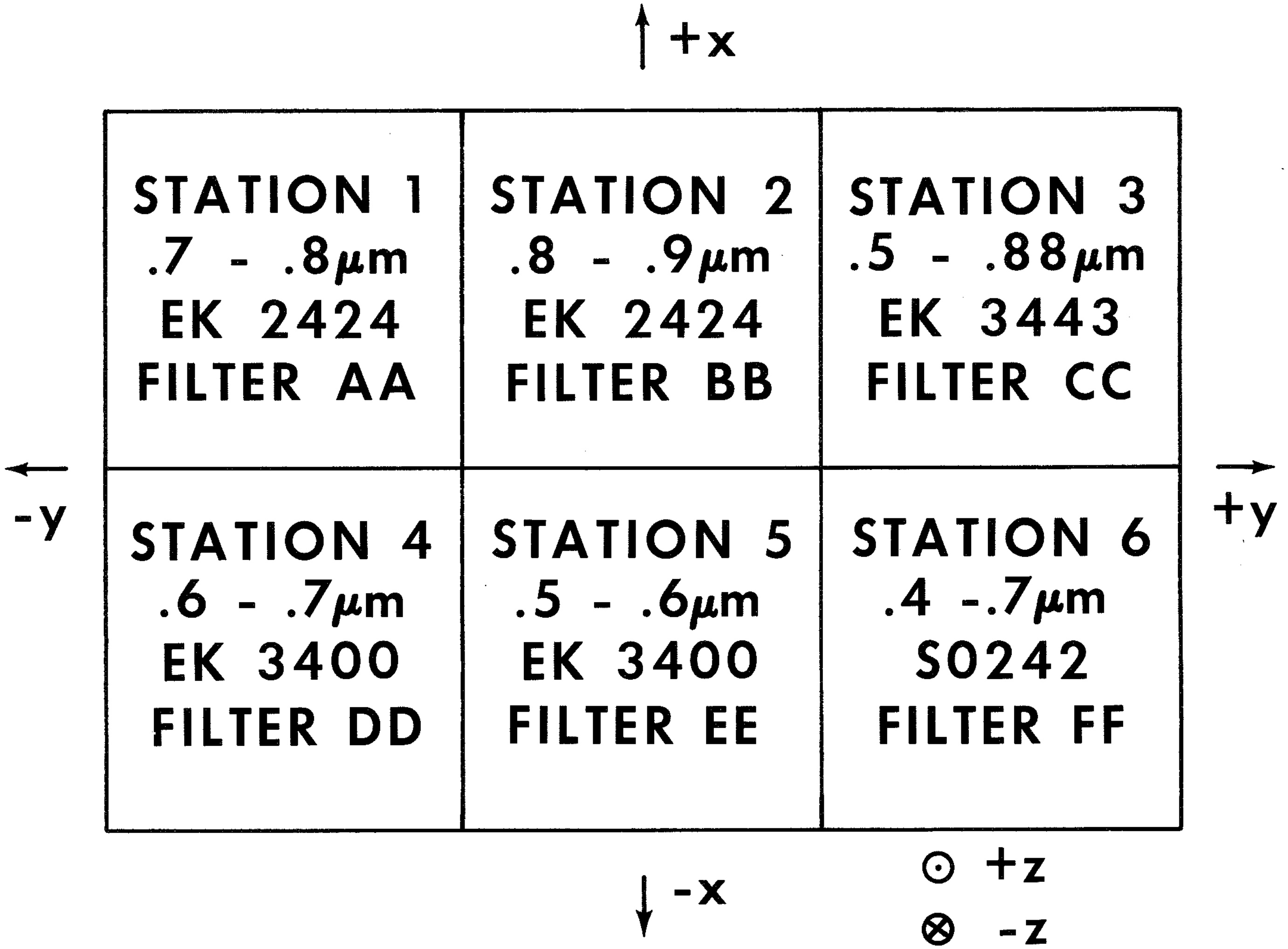
TRANSMISSION ENVELOPES FOR FILTERS



NASA-S-71-13150-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

STANDARD CONFIGURATION



STATION 1 .7 - .8μm EK 2424 FILTER AA	STATION 2 .8 - .9μm EK 2424 FILTER BB	STATION 3 .5 - .88μm EK 3443 FILTER CC
STATION 4 .6 - .7μm EK 3400 FILTER DD	STATION 5 .5 - .6μm EK 3400 FILTER EE	STATION 6 .4 -.7μm S0242 FILTER FF

NASA-S-71-13156-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

RESOLUTION AT LOW CONTRAST (1.6 TO 1)

WAVELENGTH (MICROMETERS)	FILM	REQUIRED DYNAMIC RESOLUTION (LP/MM)	EXPECTED DYNAMIC RESOLUTION (LP/MM)	RESOLUTION REGISTERED (LP/MM)
.5 - .6	PAN-X B&W	49	53	45
.6 - .7	PAN-X B&W	51	63	
.7 - .8	IR B&W	21	26	
.8 - .9	IR B&W	21	26	
.5 - .88	IR COLOR	21	31	
.4 - .7	HI RES COLOR	45	53	

NASA-S-71-13154-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

GROUND RESOLUTION AT LOW CONTRAST (1.6 TO 1)

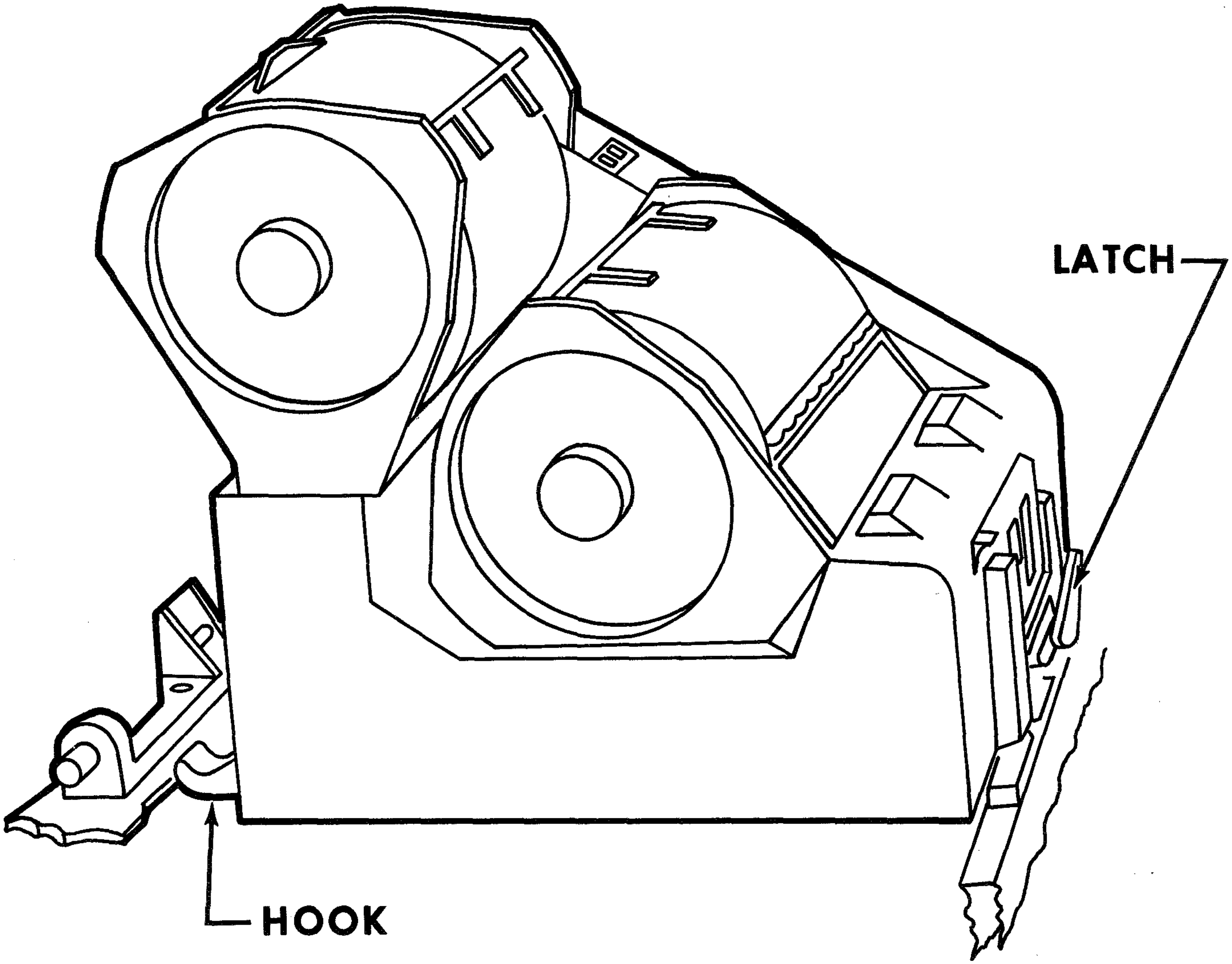
WAVELENGTH (MICROMETERS)	FILM	REQUIRED DYNAMIC RESOLUTION (FT)	EXPECTED DYNAMIC RESOLUTION (FT)	RESOLUTION REGISTERED (FT)
.5 - .6	PAN-X B&W	191	176	210
.6 - .7	PAN-X B&W	184	176	
.7 - .8	IR B&W	450	250	
.8 - .9	IR B&W	450	250	

.5 - .88	IR COLOR	450	300	
.4 - .7	HI RES COLOR	210	180	

NASA-S-71-13308-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

MAGAZINE INSTALLATION



NASA-S-71-13307-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

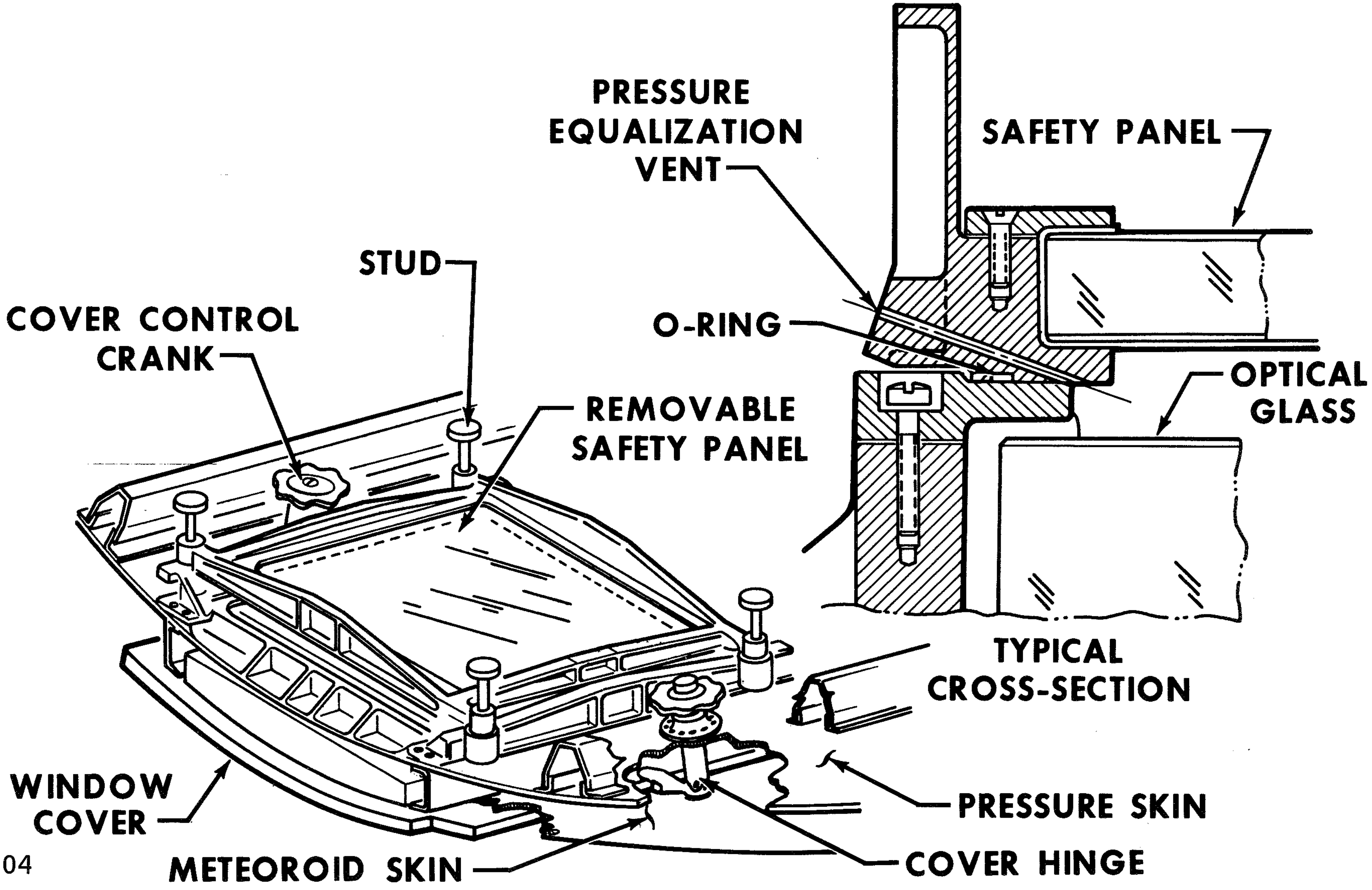
FILM TYPES

	MAGAZINE SET		
	A	B	C
STATION 1	2424	2424	TBD (2424)
STATION 2	2424	2424	TBD (2424)
STATION 3	3443	3443	TBD (3443)
STATION 4	3400	3400	TBD (3400)
STATION 5	3400	3400	TBD (3400)
STATION 6	S0242	S0242	TBD (S0242)

NASA-S-71-13312-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

MDA WINDOW ASSEMBLY



NASA-S-71-13299-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

WINDOW REQUIREMENTS

- SIZE
  - 13.5 BY 19.75 INCHES
- OPTICAL QUALITY
  - WAVEFRONT VARIATION LESS THAN 0.06 MICROMETERS FROM ORIGINAL PLANE (ANY 3-INCH DIAMETER AREA)
  - WAVEFRONT VARIATION LESS THAN 0.012 MICROMETERS FROM BEST RMS FIT PLANE (ANY 3-INCH DIAMETER AREA)
- TRANSMISSION (WITH ELECTROCONDUCTIVE COATING)

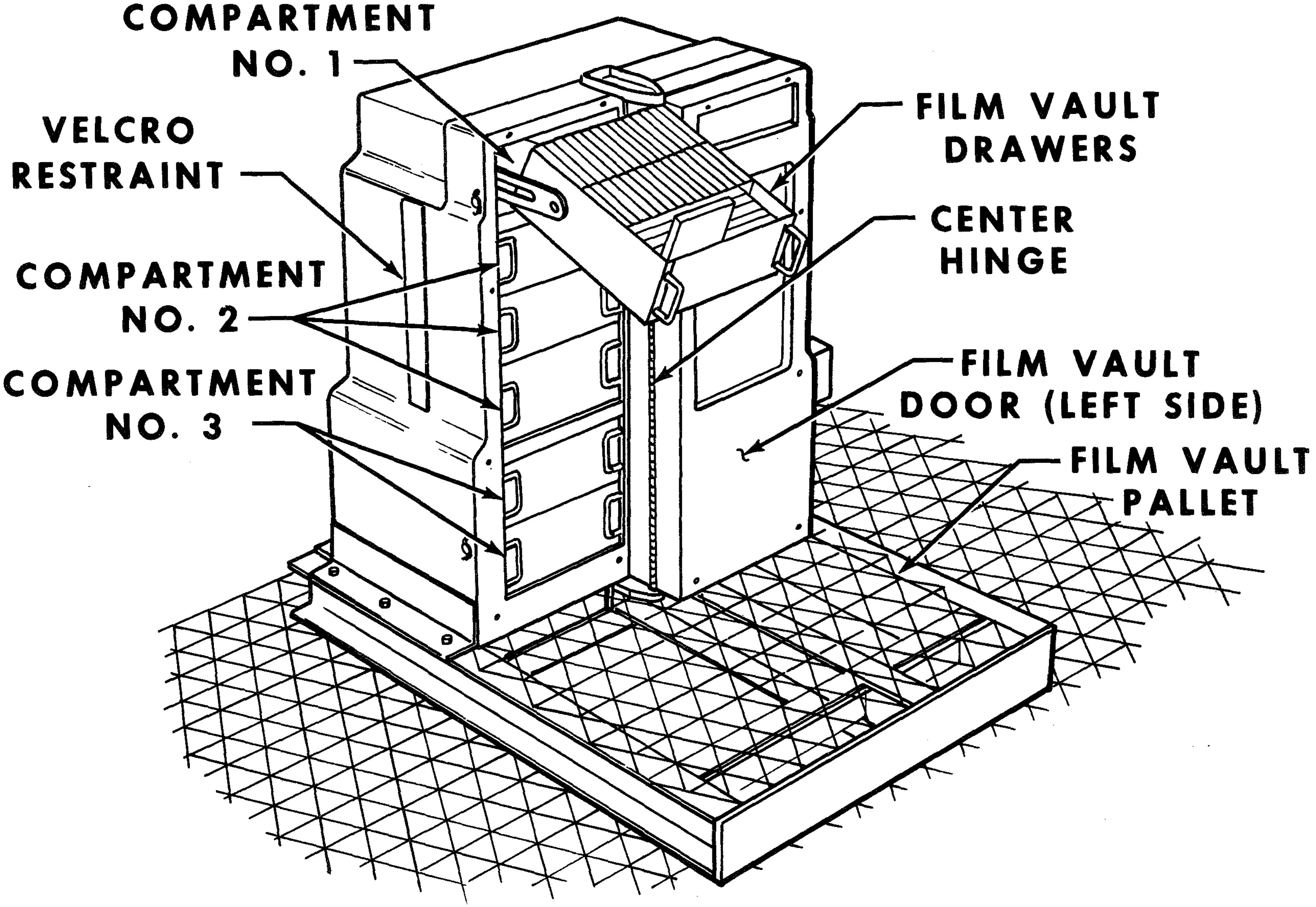
WAVELENGTH	TRANSMISSION
0.4 TO 0.45	65 PERCENT
0.45 TO 0.70	77 PERCENT
0.70 TO 0.90	63 PERCENT

- PARALLELISM
  - 2 ARC SECONDS
- SEEDS AND BUBBLES
  - CROSS SECTION LESS THAN 0.10 $mm^2/100\ cm^3$ VOLUME
- REFLECTANCE, SURFACE QUALITY, VEILING GLARE
  - REFERENCE ICD 13M 12201
- CONDENSATION
  - NONE

NASA-S-71-13311-S

S190 MULISPECTRAL PHOTOGRAPHIC FACILITY

ORBITAL WORKSHOP FILM VAULT INTERIOR



NASA-S-71-13152-S

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY

OPERATIONAL MODE

- GROUND UPDATE FOR EACH PHOTO REVOLUTION GIVING THE FILM AND FILTER COMBINATION AND THE FOLLOWING FOR EACH PHOTO SEQUENCE
  - GREENWICH MEAN TIME (GMT) OF FIRST EXPOSURE
  - INTERVALOMETER SETTING
  - NUMBER OF EXPOSURES
  - SHUTTER SPEED
  - CALIBRATION PROGRAM TO INCLUDE PRE AND POST FLIGHT EXPOSURE OF STEP WEDGES ON THE FILM

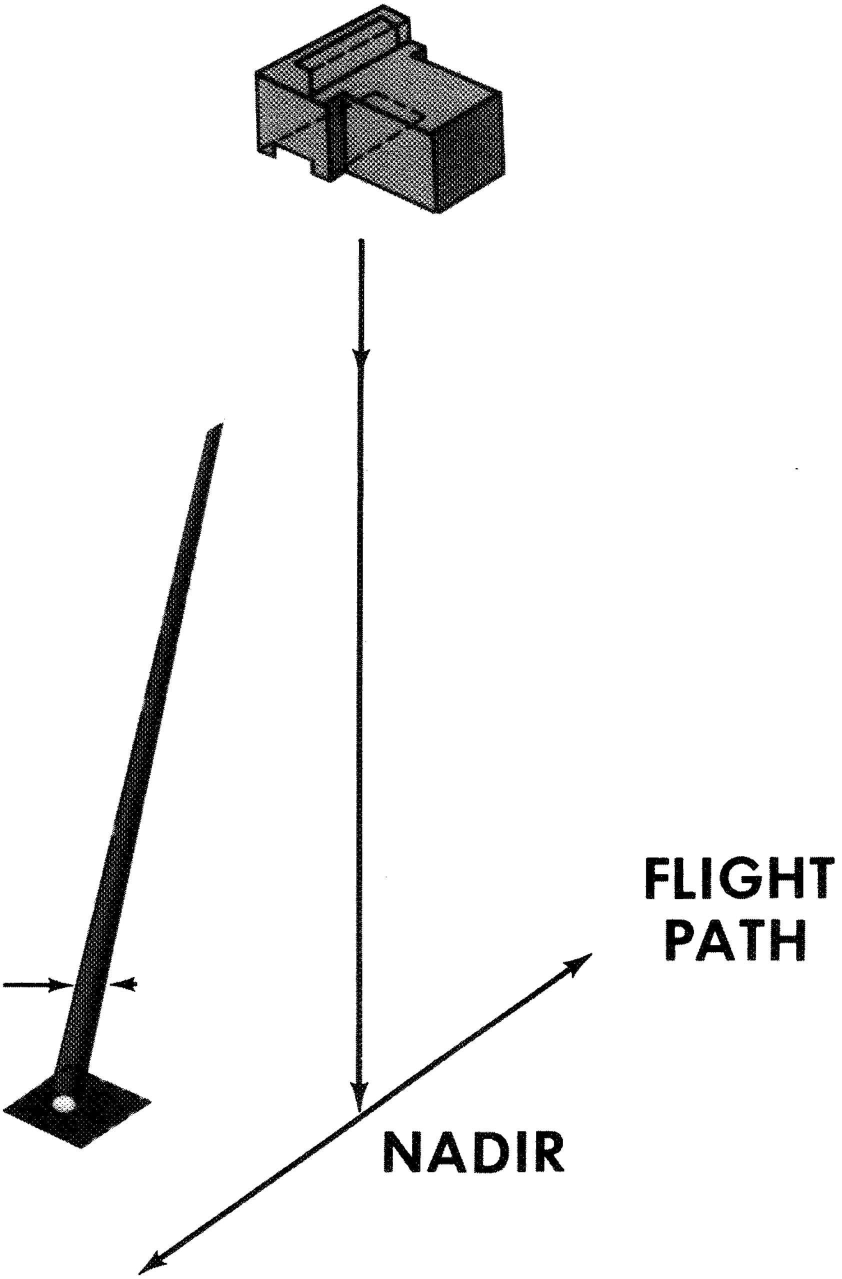
NASA-S-71-13151-X

S190 MULTISPECTRAL PHOTOGRAPHIC FACILITY
CREW PARTICIPATION

- LOAD FILM CASSETTES INTO FILM MAGZINES (SL-3 AND SL-4)
- CHECK OUT CAMERA
- INSTALL PROPER FILM MAGAZINE SET FOR EACH GROUND UPDATE
- INSTALL PROPER FILTERS FOR EACH GROUND UPDATE
- OPERATE CAMERAS
- MONITOR EQUIPMENT OPERATION
- CONDUCT APPROPRIATE CORRECTIVE ACTION IN EVENT OF EQUIPMENT MALFUNCTION
- RETRIEVE FILM INCLUDING MAGAZINE DOWNLOADING
- RETRIEVE FILTERS ON FINAL FLIGHT

NASA-S-71-13169-X

S191 INRARED SPECTROMETER



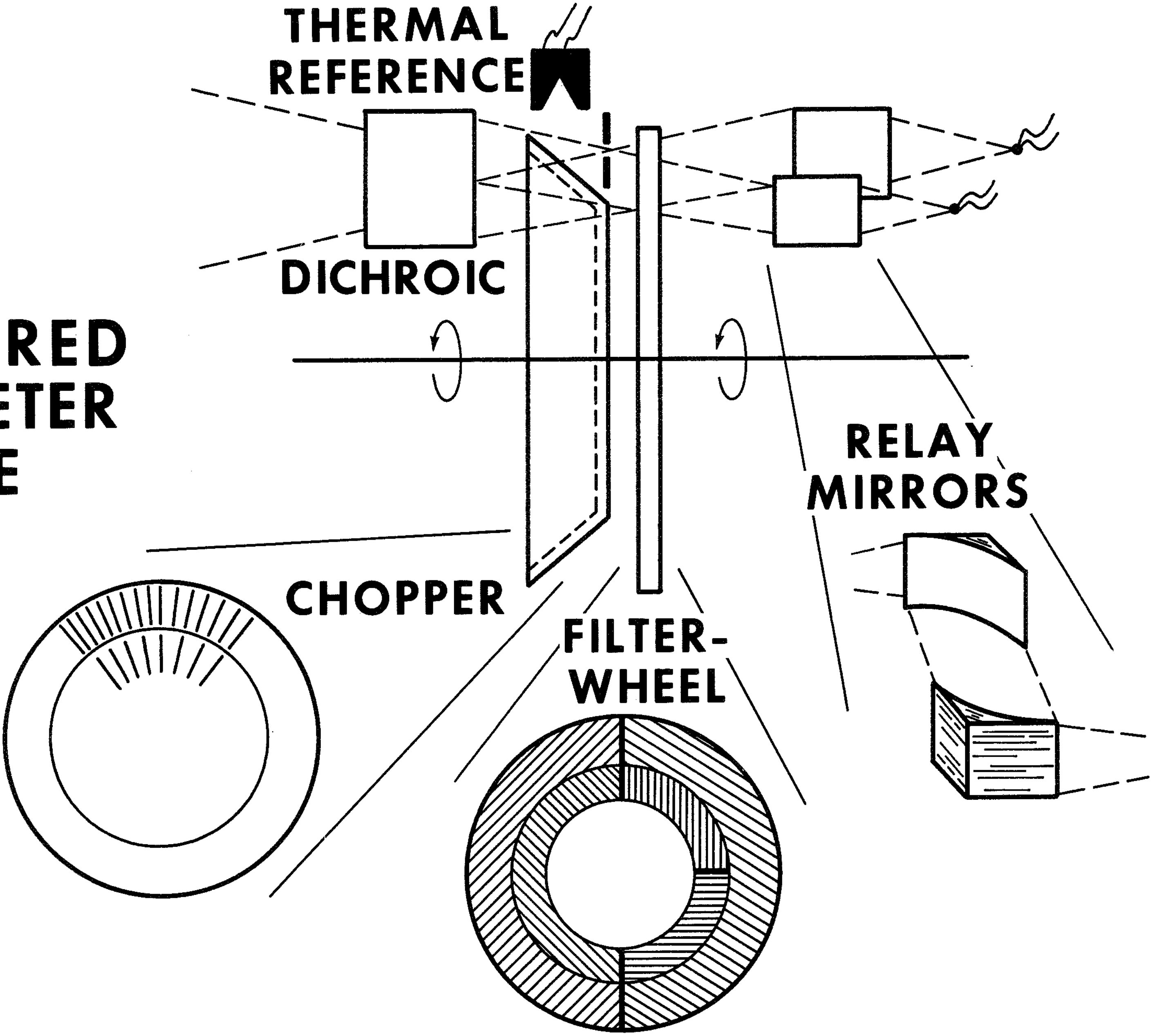
NASA-S-70-14755-V

S191 INFRARED SPECTROMETER

- DESCRIPTION
  - FILTERWHEEL SPECTROMETER UTILIZING CIRCULARLY VARIABLE INTERFERENCE FILTERS
  - VIEWFINDER/TRACKER FOR ASTRONAUT TARGET ACQUISITION AND TRACKING
  - INTERNAL WAVELENGTH AND RADIANCE CALIBRATION
  - AT ORBITAL ALTITUDE, RECORDS RADIANCE FROM EARTH SURFACE
    - SOLAR RADIANCE IN .4- TO 2.4-μ m REGION
    - EMITTED THERMAL RADIANCE IN 6.2- TO 15.5-μ m REGION

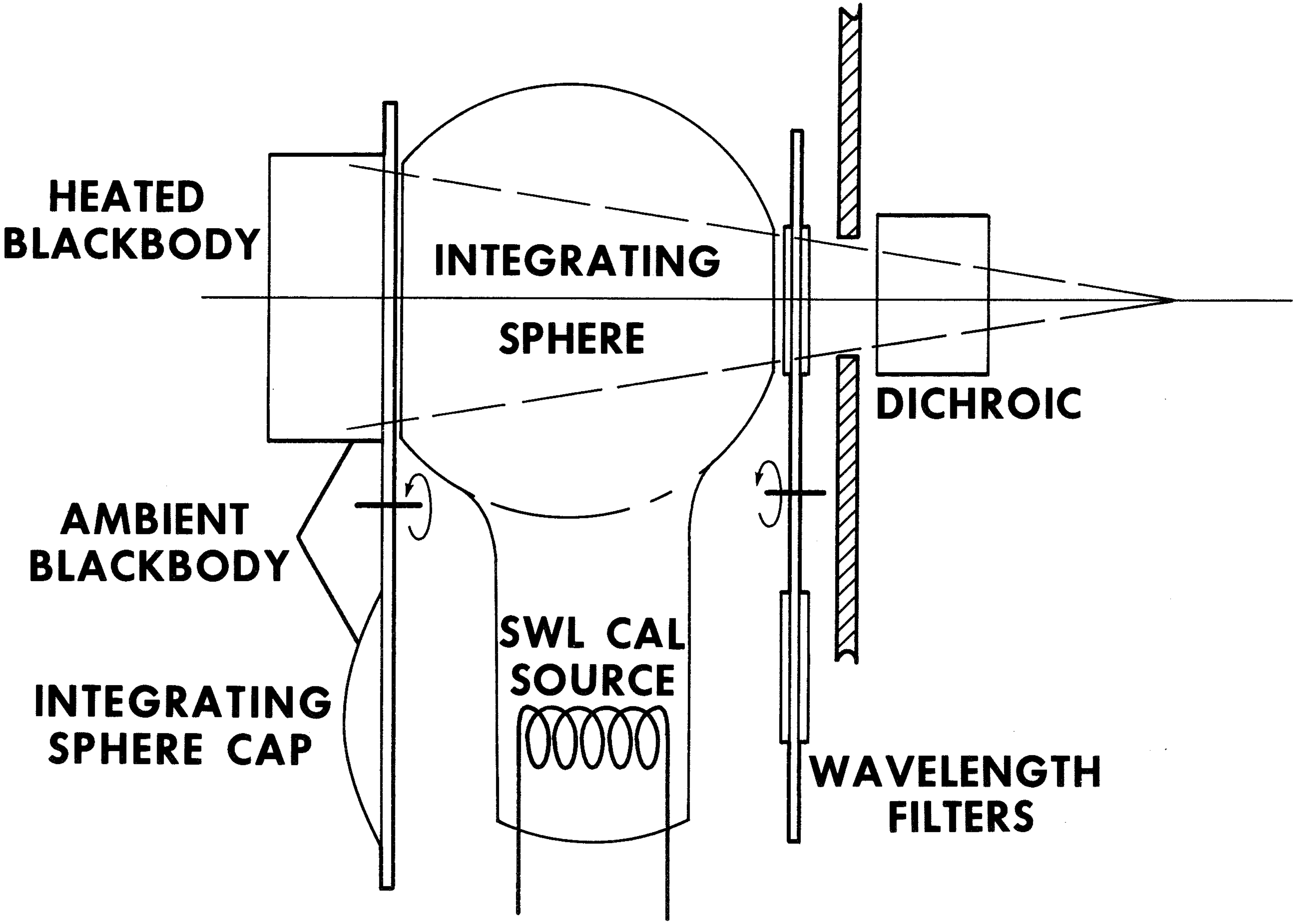
NASA-S-71-13176-X

S191 INFRARED SPECTROMETER MODULE



NASA-S-71-13174-X

S191 INFRARED SPECTROMETER CALIBRATION MODULE



S191 INFRARED SPECTROMETER

- OBJECTIVE
  - PERFORM CONTROLLED EXPERIMENTS IN WHICH APPLICABILITY OF .4- TO 2.4-μm AND 6.2- TO 15.5-μm REGION OF SPECTRUM IS QUANTITATIVELY EVALUATED FROM SPACE
- GROUND SITES ACTIVELY ACQUIRED AND TRACKED BY FLIGHT CREW USING SPECTROMETER VIEWFINDER/TRACKING SYSTEM
- PHYSICAL CHARACTERISTICS
  - DIMENSIONS: 19- BY 20- BY 51-IN. EXTERNAL ENVELOPE (MAX)
  - VOLUME: ≈ 11.2 CU FT
  - WEIGHT: ≈ 402 LB (TOTAL)
  - POWER: ≈200 W (AVG)

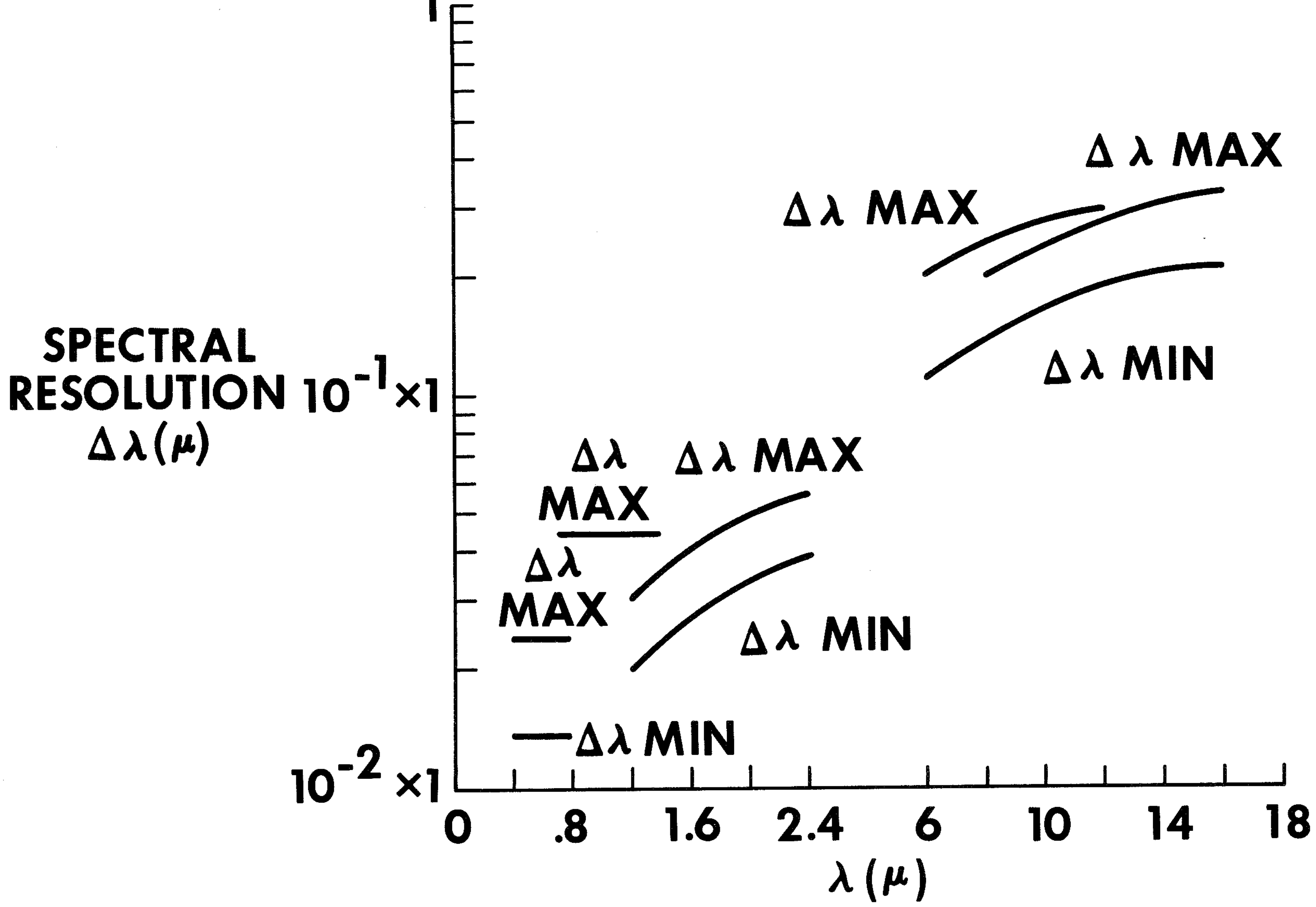
NASA-S-71-13242-V

S191 INFRARED SPECTROMETER

- DESIGN FEATURES
  - CIRCULARLY VARIABLE FILTERWHEEL
  - ~~10-~~ 25 cm IN. CASSEGRAIN COLLECTING TELESCOPE
  - FULL INTERNAL RADIANCE AND WAVELENGTH CALIBRATION
  - THERMAL DETECTOR
    - MERCURY-CADMIUM-TELLURIDE
    - COOLED BY MINATURIZED CLOSED-CYCLE ENGINE
- SPECTRAL CHARACTERISTICS
  - .4 TO 2.4 μm AND 6.2 TO 15.5 μm
  - 1 SCAN/SEC

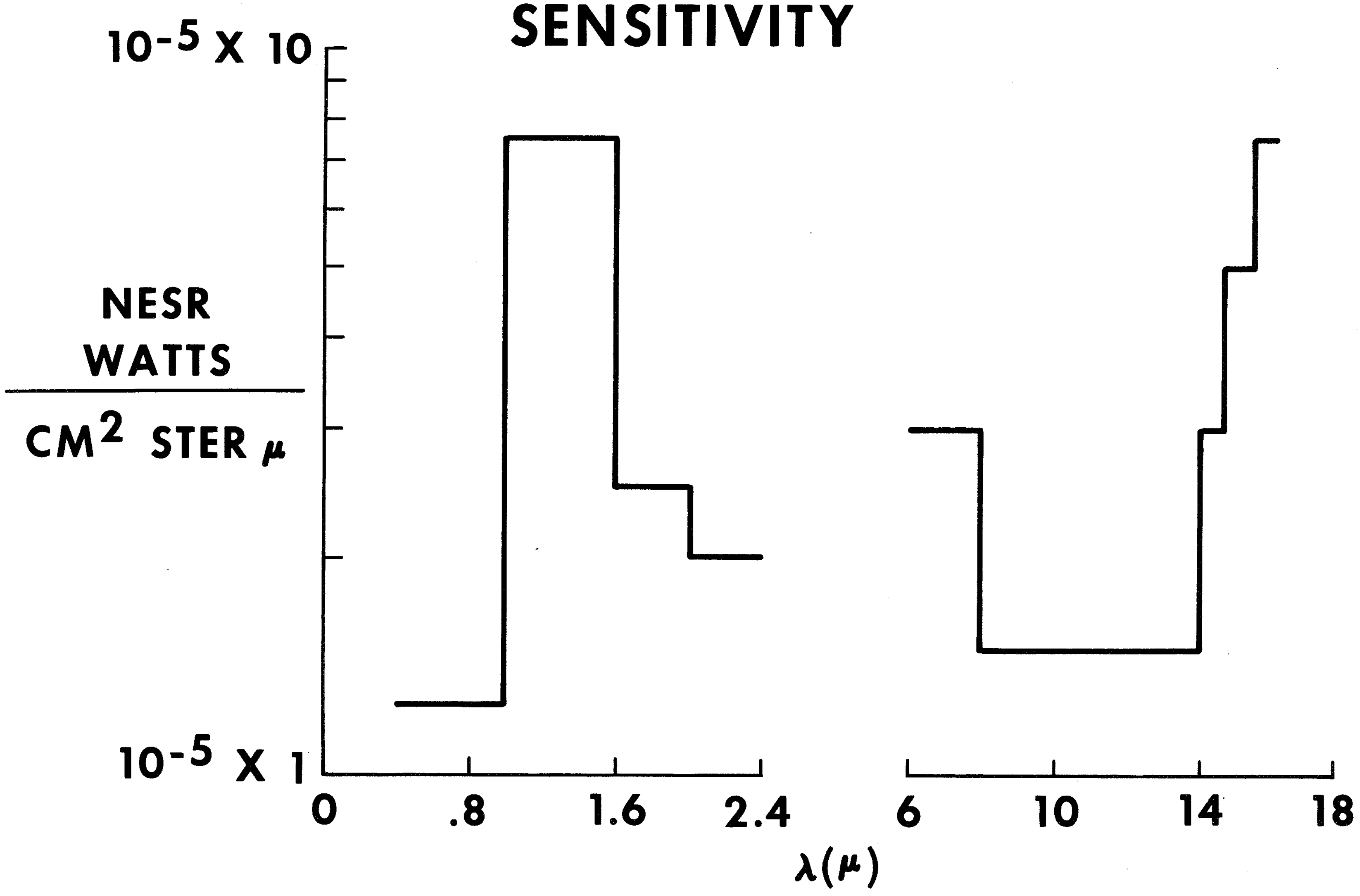
NASA-S-71-13173-X

S191 INFRARED SPECTROMETER SPECTRAL RESOLUTION



NASA-S-71-13171-X

S191 INFRARED SPECTROMETER SENSITIVITY



NASA-S-71-13207-V

S191 INFRARED SPECTROMETER

- SPATIAL CHARACTERISTICS
  - 1 mRAD INSTANTANEOUS FOV (1/4-N MI DIAMETER CIRCLE AT NADIR)
  - SMALL TARGETS TRACKED BY ASTRONAUT FOR ONE OR MORE SCANS
- DATA CHARACTERISTICS
  - RECORDED ONBOARD BY EREP TAPE RECORDER
  - DATA SAMPLES BY PCM SYSTEM AT 684 SAMPLES/SEC
    - 10-BIT ACCURACY
    - 2 CHANNELS: .4 TO 2.4μ m AND 6.2 TO 15.5μ m
  - TAPE DECOMMUTATED AND REFORMATTED ON GROUND

S191 INFRARED SPECTROMETER

- OPERATOR PARTICIPATION
  - ASTRONAUT PARTICIPATION ESSENTIAL
    - MUST VISUALLY ACQUIRE SMALL TARGETS (≈ 1-N MI DIAMETER)
    - MUST TRACK MANUALLY WHILE ACQUIRING DATA
    - MUST ACTUATE AUTOMATIC CALIBRATION SEQUENCE BEFORE AND AFTER EACH EREP PASS

NASA-S-71-13179-X

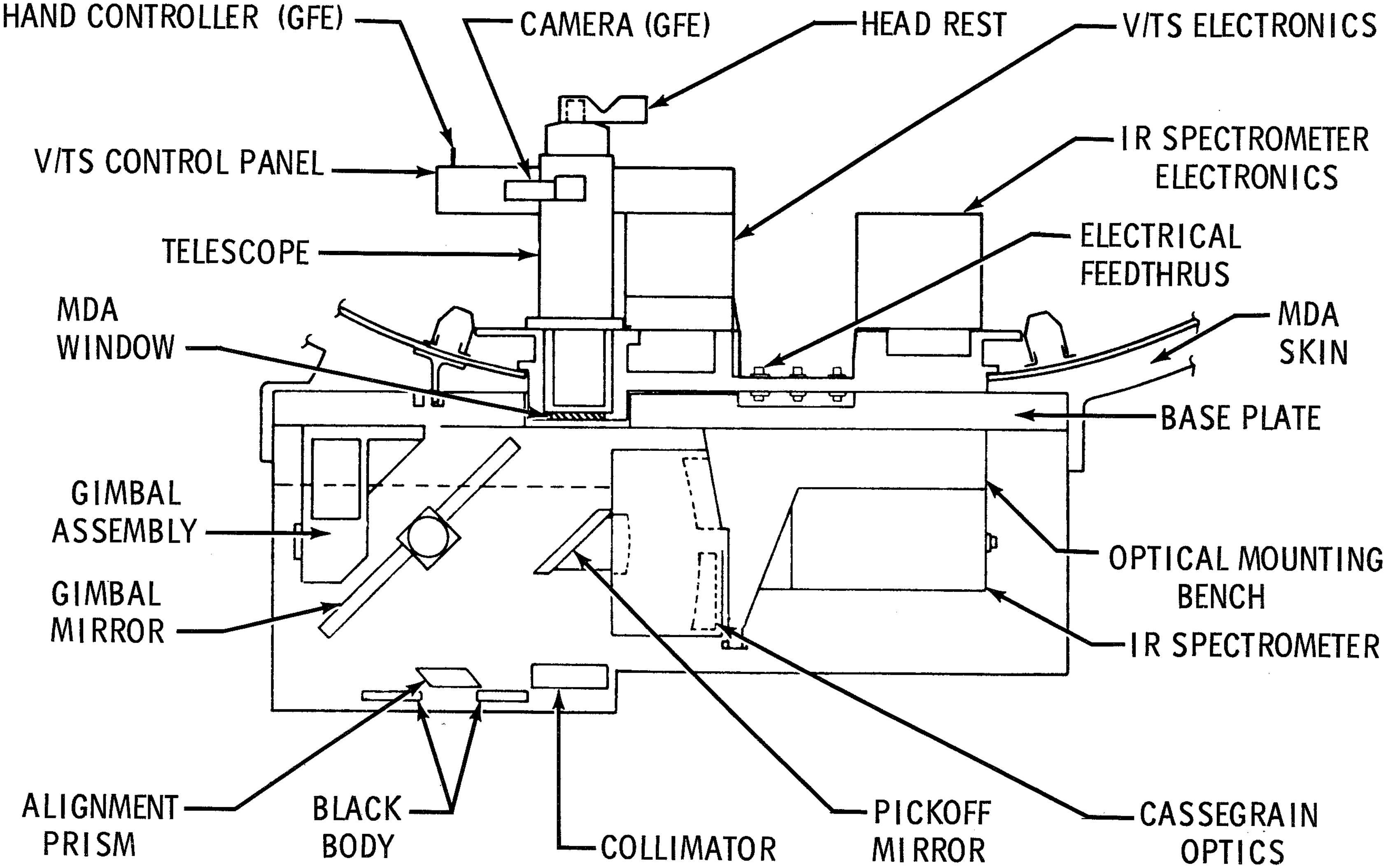
S191 INFRARED SPECTROMETER

VIEWFINDER/TRACKER SYSTEM

- GIMBALLED TRACKING MIRROR
- VIEWFINDER TELESCOPE
- BORESIGHTED 16-mm CAMERA
- ASTRONAUT CONTROLS POINTING AND TRACKING
- CONTAMINATION COVER WITH BLACKBODY
- ALIGNMENT SYSTEM
- VIEWFINDER FOV 17 DEG (70 N MI)
- POINTING LIMITS: 45 DEG AHEAD, 10 DEG BACK, 20 DEG TO SIDE

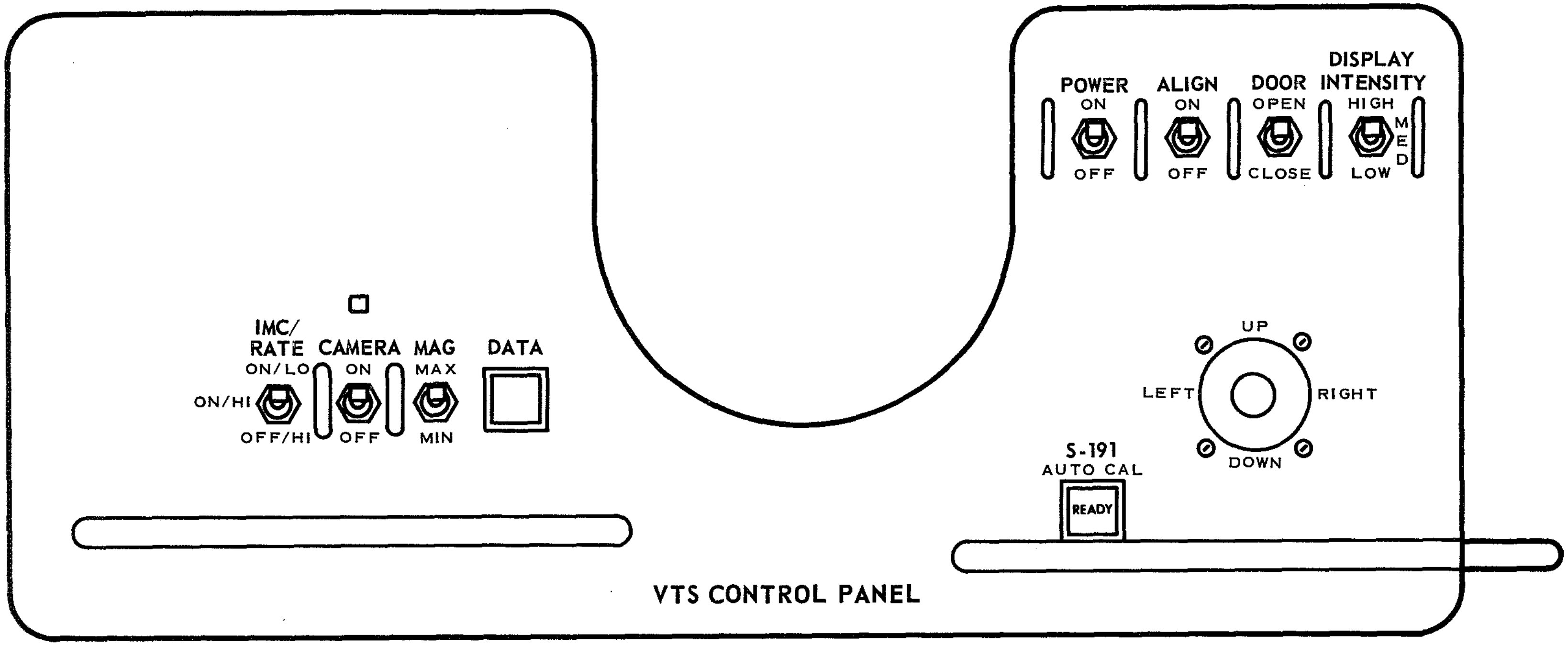
NASA-S-71-13195-V

S191 INFRARED SPECTROMETER VIEWFINDER TRACKING SYSTEM



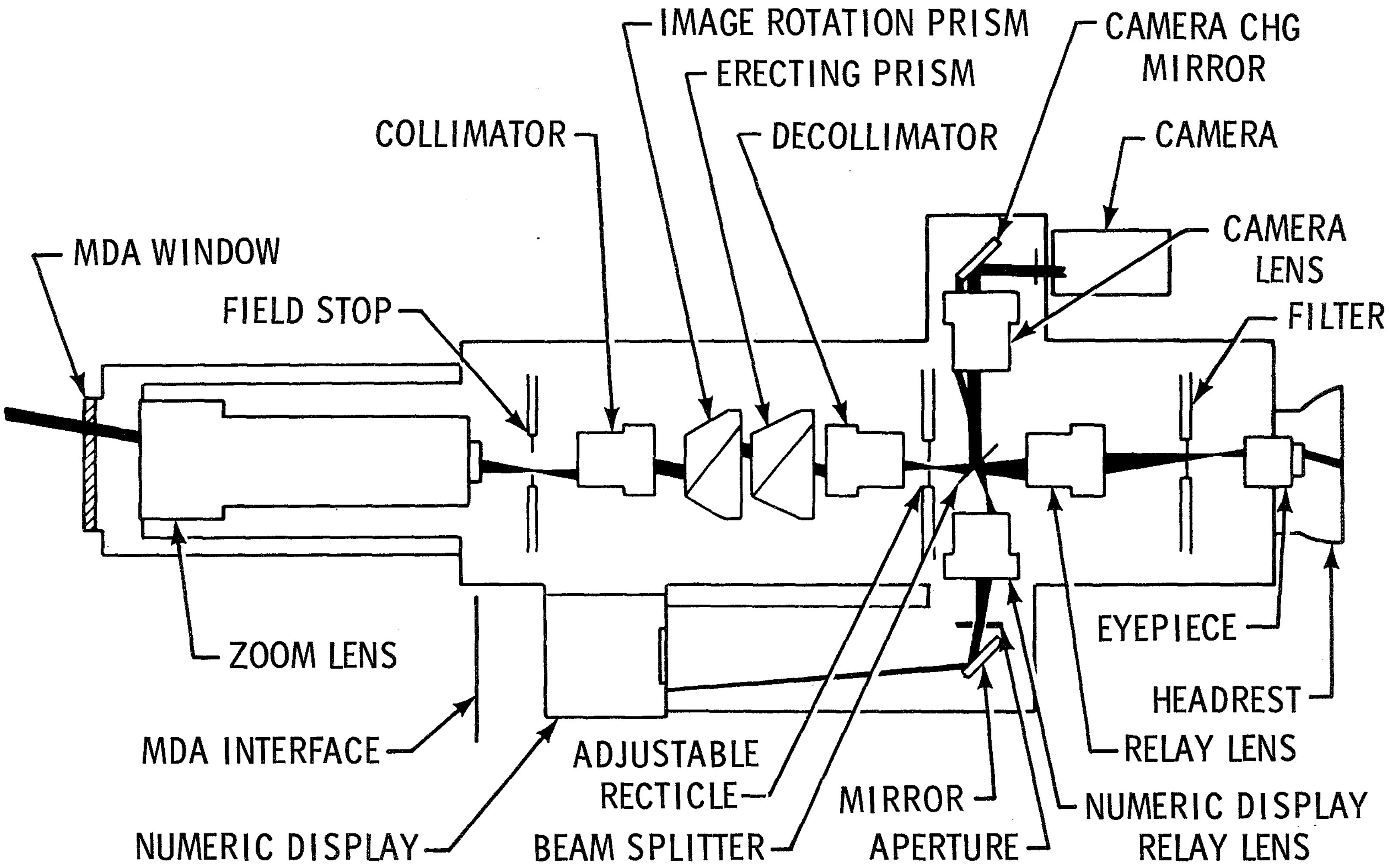
NASA-S-71-13256-V

S191 INFRARED SPECTROMETER



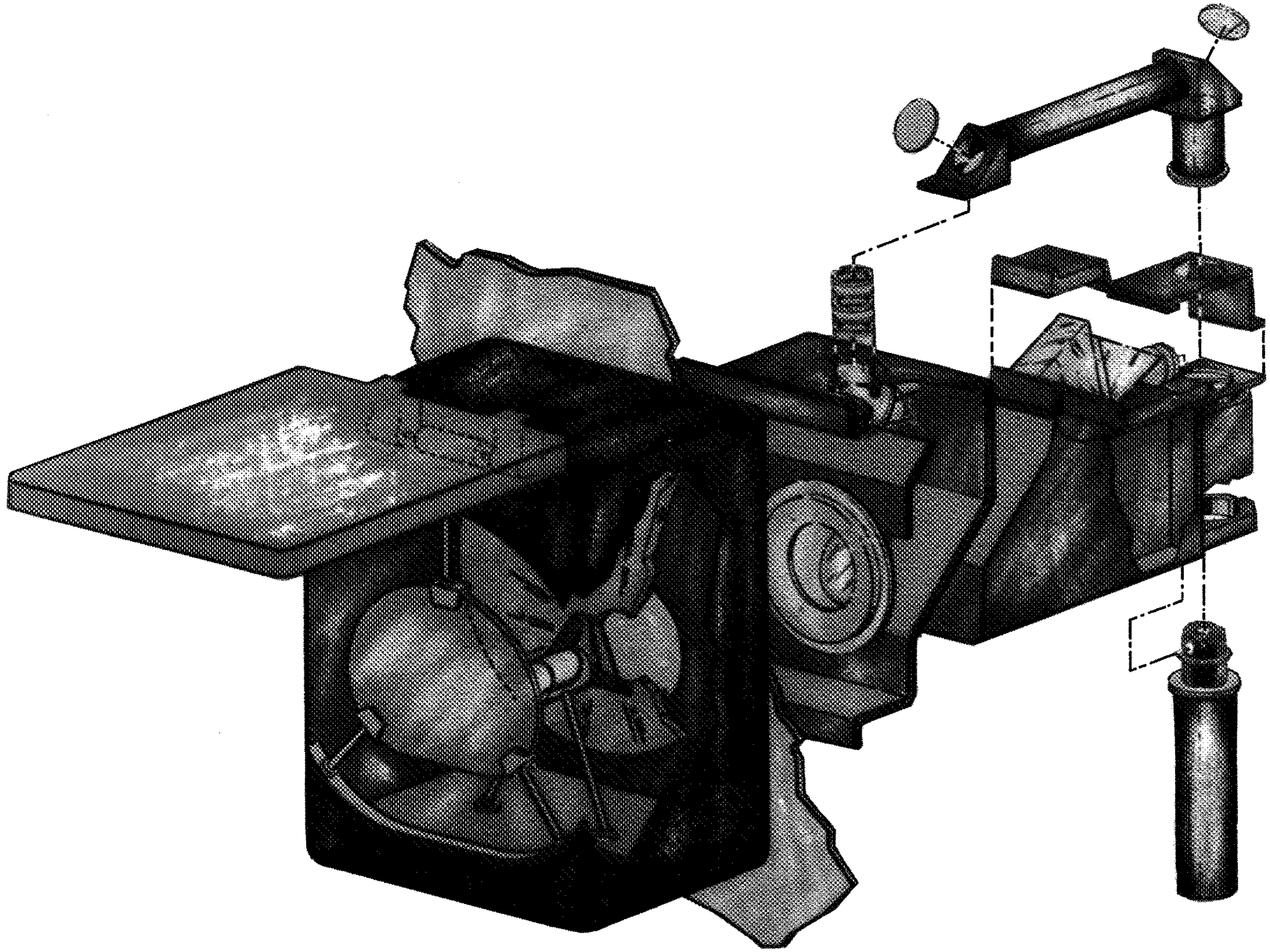
NASA-S-71-13199-V

S191 INFRARED SPECTROMETER VIEWFINDER TRACKING SYSTEM TELESCOPE OPTICS



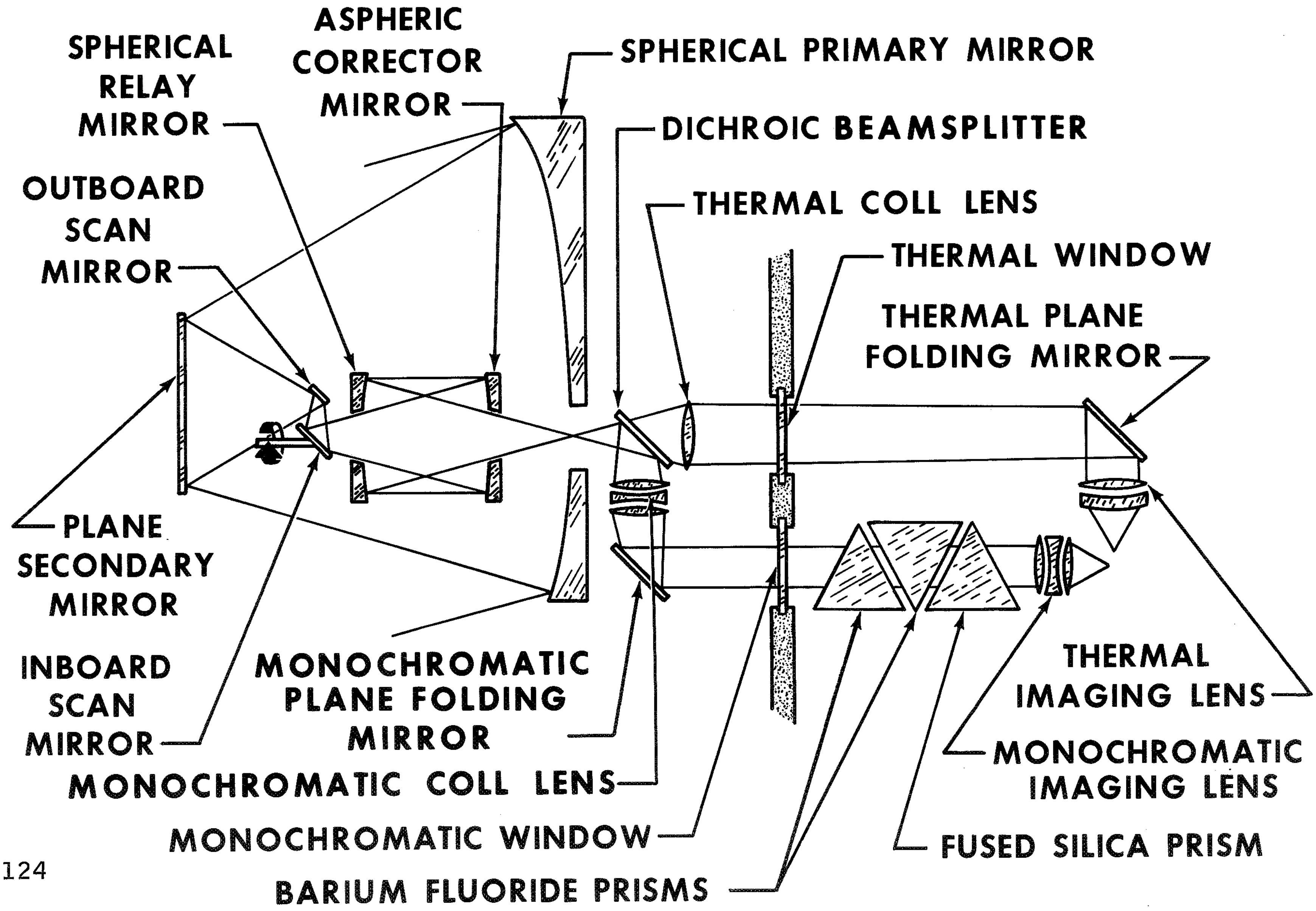
NASA-S-71-12744-X

S192 MULTISPECTRAL SCANNER



NASA-S-71-13180-S

S192 MULTISPECTRAL SCANNER OPTICAL SCHEMATIC



NASA-S-70-14743-V

S192 MULTISPECTRAL SCANNER

- DESCRIPTION
  - RADIOMETER THAT OPTICALLY SCANS SUCCESSIVE CONTINGUOUS LINES ACROSS FLIGHT PATH
  - RECORDS SIMULTANEOUSLY, IN THIRTEEN DISCRETE SPECTRAL INTERVALS, ENERGY REFLECTED AND EMITTED BY EARTH FEATURES
    - VISIBLE
    - INFRARED
  - RECORDS REFLECTED ENERGY WITH SENSITIVITY BETTER THAN 1 PERCENT NOISE EQUIVALENT REFLECTANCE
  - RECORDS EMITTED ENERGY TO SENSITIVITY OF .4° K

NASA-S-71-13266-V

S192 MULTISPECTRAL SCANNER

- OBJECTIVE
  - GATHER QUANTITATIVE HIGH-SPATIAL-RESOLUTION LINE-SCAN IMAGERY DATA ON RADIATION REFLECTED AND EMITTED BY SELECTED GROUND SITES IN U.S.

- PHYSICAL CHARACTERISTICS
  - DIMENSIONS (PRELIMINARY)
    - SCANNER: 29 BY 34.5 BY 23.2 IN.
    - SPECTROMETER: 22 BY 24.5 BY 15 IN.
    - ELECTRONICS ASSEMBLY: 17.32 BY 16.5 BY 10 IN.
  - VOLUME (PRELIMINARY)
    - SCANNER: 13.5 CU FT
    - SPECTROMETER: 4.7 CU FT
    - ELECTRONICS ASSEMBLY: 1.2 CU FT
  - WEIGHT
    - SCANNER: 125 LB
    - SPECTROMETER: 100 LB
    - ELECTRONICS ASSEMBLY: 75 LB
  - POWER
    - 266 W (PEAK)

S192 MULTISPECTRAL SCANNER

- DESIGN FEATURES
  - CONICAL LINE SCAN
  - SPECTRAL SEPARATION ACCOMPLISHED IN DISPERSIVE MANNER
  - EACH CHANNEL RADIOMETRICALLY CALIBRATED 100 TIMES/SEC
  - DATA BUFFERED TO ELIMINATE EFFECT OF FINITE DUTY CYCLE
- SPECTRAL CHARACTERISTICS
  - 13 SPECTRAL BANDS FROM .40 TO 12.5 μm WITH SPECTRAL BANDWIDTH FROM 0.05 TO 2.3 μm

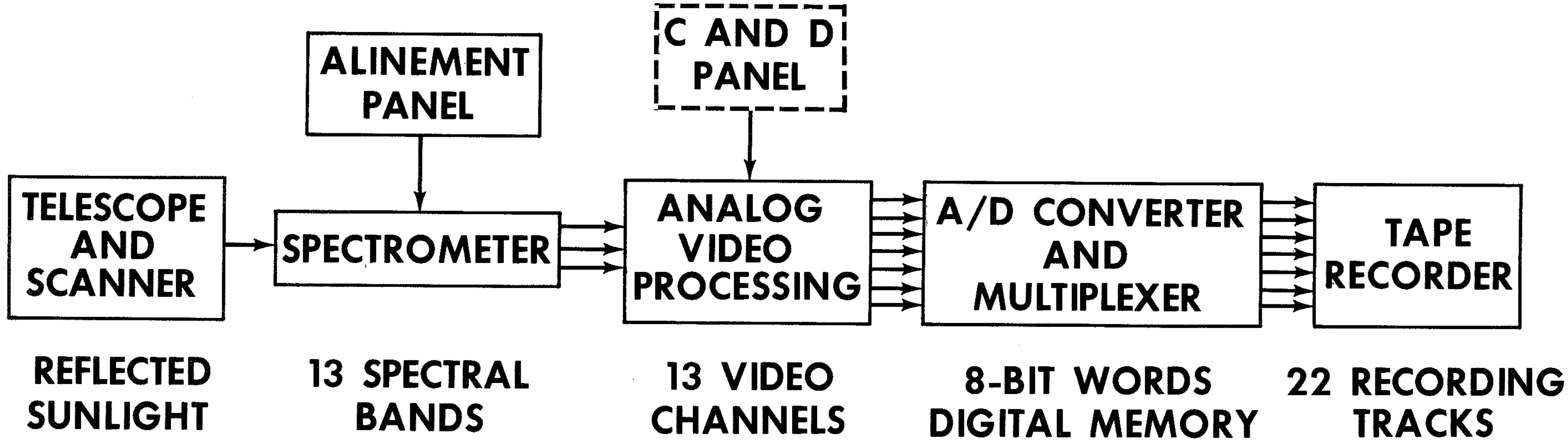
NASA-S-71-13272-S

S192 MULTISPECTRAL SCANNER
SENSOR CHARACTERISTICS

SCANNER	IMAGE PLANE CONICAL SCANNER
COLLECTOR	SPHERE-17 INCH INSTANTANEOUS COLLECTING APERTURE
INSTANTANEOUS FIELD OF VIEW	0.182 MILLIRADIANS-260 FEET 79 m
SPECTRAL SEPARATION	
BAND 1-12	PRISM SPECTROMETER
BAND 13	DICHROIC FILTER
CALIBRATION	TUNGSTEN LAMP AND SPARE TWO SMALL BLACKBODY SOURCES AND SPARE
NUMBER OF 8-BIT WORDS PER SECOND PER BAND	125,000
NOISE EQUIVALENT REFLECTIVITIES FOR BANDS 1-12	1.0 PERCENT FOR 2 AIR MASS ATTENUATION AND A 45 DEG SOLAR ANGLE
NOISE EQUIVALENT TEMPERATURE	0.4 DEG K

NASA-S-71-13185-S

S192 MULTISPECTRAL SCANNER BLOCK DIAGRAM



NASA-S-71-13178-X

S192 MULTISPECTRAL SCANNER CHARACTERISTICS

- SPECTRAL RANGE
  - 0.4 - 12.5 μM
- NO. BANDS
  - 13
- INSTANTANEOUS FIELD OF VIEW
  - 260 FT 79M
  - 0.182 mRAD
- SPATIALLY-REGISTERED AUTOMATICALLY CALIBRATED SYSTEM

NASA-S-71-13177-S

S192 MULTISPECTRAL SCANNER PARAMETERS

RADIUS OF SCAN CIRCLE	22.6 N MI	41.8 km
PORTION OF CIRCLE USED	120 DEG	
SWATH WIDTH	39.1 N MI	72.4 km
INFORMATION RATE PER SCAN LINE PER DETECTOR	1100 RESOLUTION ELEMENTS PER LINE	
SPATIAL REGISTRATION	0.1 RESOLUTION ELEMENTS	
ELECTRICAL BANDWIDTH	167 KHz	
LINEARITY	0.5 PERCENT	
RELATIVE CALIBRATION ACCURACY	1 PERCENT	
ABSOLUTE ACCURACY		
VISIBLE-NEAR INFRARED	5 PERCENT	
THERMAL INFRARED	0.5 DEG K	
A TO D CONVERSION	8 BIT WORDS	

NASA-S-71-13181-X

S192 MULTISPECTRAL SCANNER SPECTRAL BANDS

0.41–0.46 μM
0.46–0.51
0.52–0.56
0.56–0.61
0.62–0.67
0.68–0.76

0.78 – 0.88 μM
0.98 – 1.08
1.09 – 1.19
1.20 – 1.30
1.55 – 1.75
2.10 – 2.35
10.2 – 12.5

NASA-S-71-13175-S

S192 MULTISPECTRAL SCANNER PERFORMANCE

	BAND (MICRONS)	ATMOSPHERIC TRANSMISSION	NOISE EQUIVALENT REFLECTIVITY (PERCENT)
1	0.41-0.46	0.45	1.0
2	0.46-0.51	0.45	1.0
3	0.52-0.56	0.55	1.0
4	0.56-0.61	0.55	1.0
5	0.62-0.67	0.60	1.0
6	0.68-0.76	0.65	1.0
7	0.78-0.88	0.70	1.0
8	0.98-1.08	0.80	0.9
9	1.09-1.19	0.50	1.0
10	1.20-1.30	0.80	0.6
11	1.55-1.75	0.70	0.55
12	2.10-2.35	0.70	1.3
13	10.2-12.5	0.90	0.4 DEG K*

SCENE REFLECTANCE - 20 PERCENT (DIFFUSE)
ANGLE OF INCIDENCE - 45 DEGREES
*300 DEG K BLACKBODY SOURCE

NASA-S-71-13184-S

S192 MULTISPECTRAL SCANNER CALIBRATION SOURCE SETTINGS

- VISIBLE - NEAR INFRARED
  - LOW LEVEL - AGRICULTURAL SCENES, OCEANS, AVERAGE ILLUMINATION CASE
  - HIGH LEVEL - SNOW, CLOUDS, HIGH ILLUMINATION CASE
- THERMAL INFRARED
  - HOT BLACKBODY - 295 DEG K, 320 DEG K
  - COLD BLACKBODY - 260 DEG K, 295 DEG K
  - MAXIMUM RANGE - 240 DEG K TO 320 DEG K

S192 MULTISPECTRAL SCANNER SPECIAL REQUIREMENTS

- LIGHTING
  - SUN ANGLE AT LEAST 30 DEG MOST DATA
  - NIGHTTIME DATA USEABLE
- ATTITUDE
  - 0.1 DEG POSTFLIGHT
- POSITION
  - 0.1 N MI POSTFLIGHT 0.2 km
- RATES
  - 0.05 DEG /SEC MAXIMUM

NASA-S-71-13200-X

S192 MULTISPECTRAL SCANNER DATA PROCESSING

USE GDS OF 24 BAND MSC SCANNER

- DATA SCREENING - CRT
- 3 BAND BLACK AND WHITE FILM
  SINGLE BAND COLOR FILM
- COMPUTER COMPATIBLE TAPE

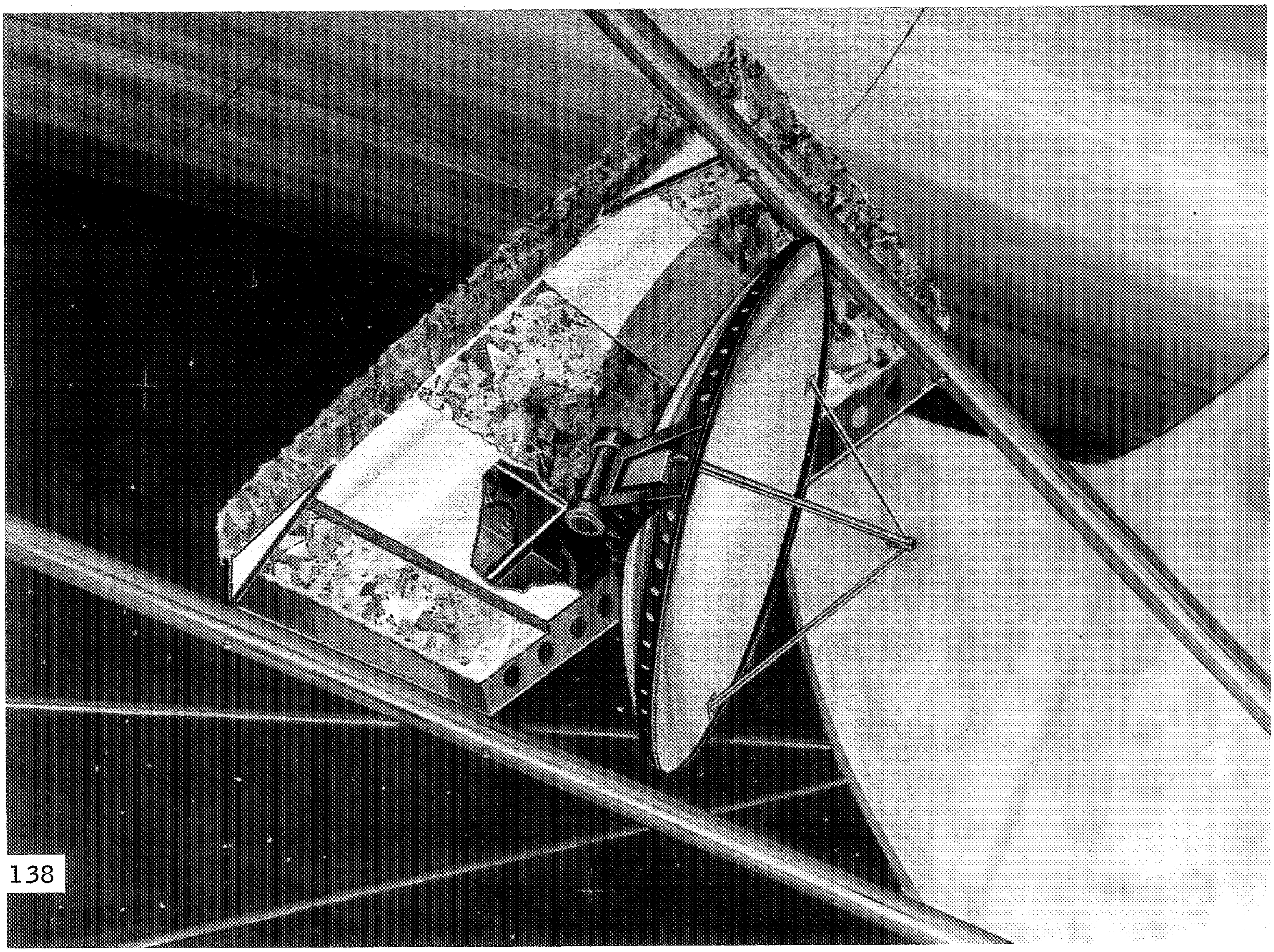
NASA-S-71-13196-X

S192 MULTISPECTRAL SCANNER CREW FUNCTIONS

- CHECKOUT
  - DETERMINE INSTRUMENT OPERABILITY
- SET CALIBRATION SOURCE LEVELS
  - DYNAMIC RANGE
- INSTRUMENT OPERATION
  - ASSESS CLOUD COVER
  - TEST SITE OPERATION
- INFLIGHT MAINTENANCE
- TAPE RETURN
  - 4 TAPE REELS PER MISSION

NASA-S-70-14737-X

S193 MICROWAVE SYSTEM



S193 MICROWAVE SYSTEM

- DESCRIPTION
  - COMBINATION ACTIVE AND PASSIVE MICROWAVE SYSTEM
    - RADIOMETER
    - SCATTEROMETER
    - ALTIMETER
  - PARABOLIC ANTENNA TRANSMITS AND RECEIVES DUAL-POLARIZED RADIATION
    - CROSS-TRACK SCAN
    - ALONG-TRACK SCAN
  - MEASURES SIMULTANEOUSLY RADAR SCATTERING-CROSS-SECTION AND MICROWAVE-EMISSIVITY AND SIGNAL-CORRELATION PROPERTIES

NASA-S-71-13235-V

S193 MICROWAVE SYSTEM

- OBJECTIVE
  - PROVIDE SIMULTANEOUS EVALUATIONS OF RADAR BACKSCATTERING-CROSS-SECTION AND PASSIVE MICROWAVE EMISSIVITY OF LAND AND SEA
  - COMPARE SURFACE BRIGHTNESS TEMPERATURE MEASUREMENTS AT TWO MICROWAVE FREQUENCIES (BY CORRELATION WITH S194 DATA)
  - PROVIDE ENGINEERING DATA FOR USE IN DESIGNING OPTIMUM RADAR ALTIMETER FOR SPACE USE
- PHYSICAL CHARACTERISTICS
  - DIMENSIONS
    - ELECTRONICS PACKAGE: 83 BY 63 BY 8 IN. 2.1 × 1.6 × 0.2 M
    - ANTENNA: 48-IN. DIAMETER 1.22 M
  - WEIGHT
    - ELECTRONICS PACKAGE AND ANTENNA: 250 LB 114 kg
  - POWER
    - 153 W, 28 V DC, AVERAGE
    - 300 W, 28 V DC, PEAK

NASA-S-71-13193-V

S193 MICROWAVE SYSTEM

- DESIGN FEATURES
  - TRAVELING-WAVE-TUBE AMPLIFIER FOR ALTIMETER AND SCATTEROMETER TRANSMITTERS
  - COMMON RECEIVER FRONT END FOR ALL SYSTEMS
  - SAMPLE AND HOLD PROCESSOR FOR ALTIMETER
  - AUTOMATIC ANTENNA NADIR ALINEMENT
  - ALTIMETER OPERATES AT NADIR AND AT ANGLES TO 15.6 DEG
- OPERATOR PARTICIPATION
  - SELECT SCAN MODE
    - CONTIGUOUS, NONCONTIGUOUS
    - CROSS TRACK, ALONG TRACK
  - SELECT INSTRUMENT COMBINATION
    - RADIOMETER
    - SCATTEROMETER
    - RADIOMETER-SCATTEROMETER
    - ALTIMETER
  - SELECT ALTIMETER MODE I TO V

NASA-S-71-13211-V

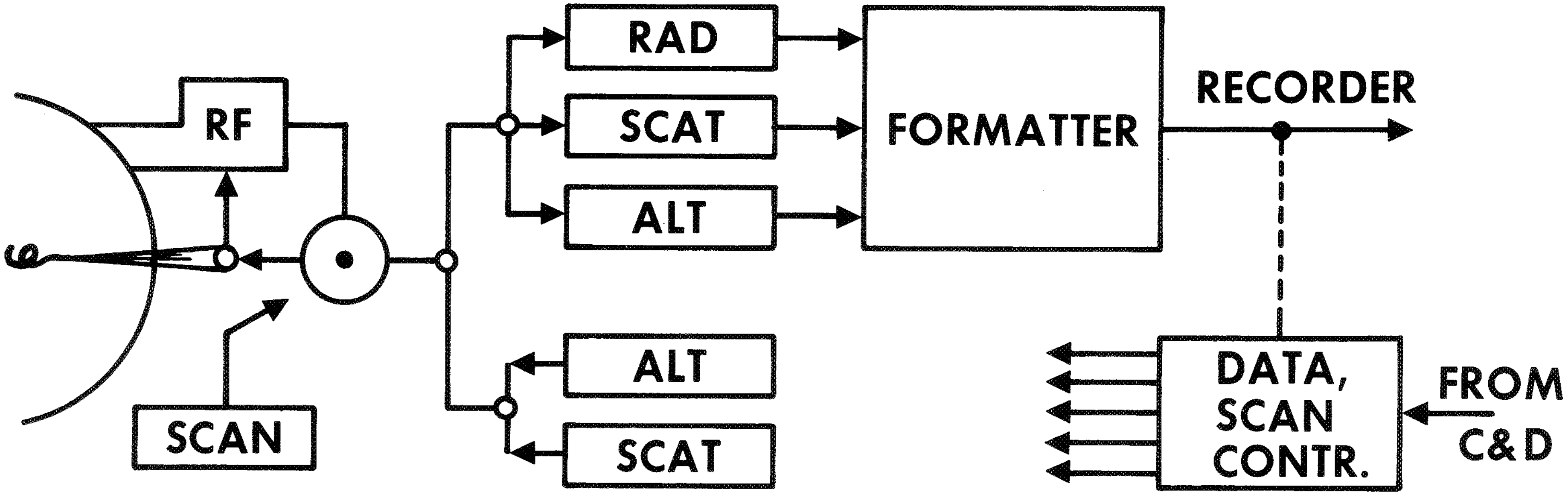
S193 MICROWAVE SYSTEM

- SPECTRAL CHARACTERISTICS
  - TRANSMITS AND RECIEVES FROM 13.8 TO 14.0 GHz
- SPATIAL CHARACTERISTICS
  - SCAN MODES
    - ALONG TRACK: 0° TO 48° FORWARD/CONTIGUOUS AND NONCONTIGUOUS
    - CROSS TRACK: 0° TO 48° NONCONTIGUOUS, ± 12.4 DEGREES CONTIGUOUS
  - AT 235 N MI, ILLUMINATES 6-N MI CONE AT NADIR

    11 KM
- DATA CHARACTERISTICS
  - 4 OR 10 KILOBIT PCM MULTIPLEXED ON ONE TAPE RECORDER TRACK

NASA-S-71-13254-S

S193 MICROWAVE SYSTEM
BASIC DESIGN



NASA-S-71-13203-S

S193 MICROWAVE SYSTEM DESIGN PARAMETERS

RAD-SCAT	ALTIMETER
13.9 GHz	13.9 GHz
20W TWT	2 KW TWT
125 PPS	250 PPS
1000°K	1000° K
23 dB S/N	20 dB S/N
4 K BIT DATA	10 K BIT DATA
DUAL POLARIZATION	SINGLE, DOUBLE PULSE
1°K -RADIOMETER	1 M 1 YARD RMS
0-48°	0-15°

NASA-S-71-13267-S

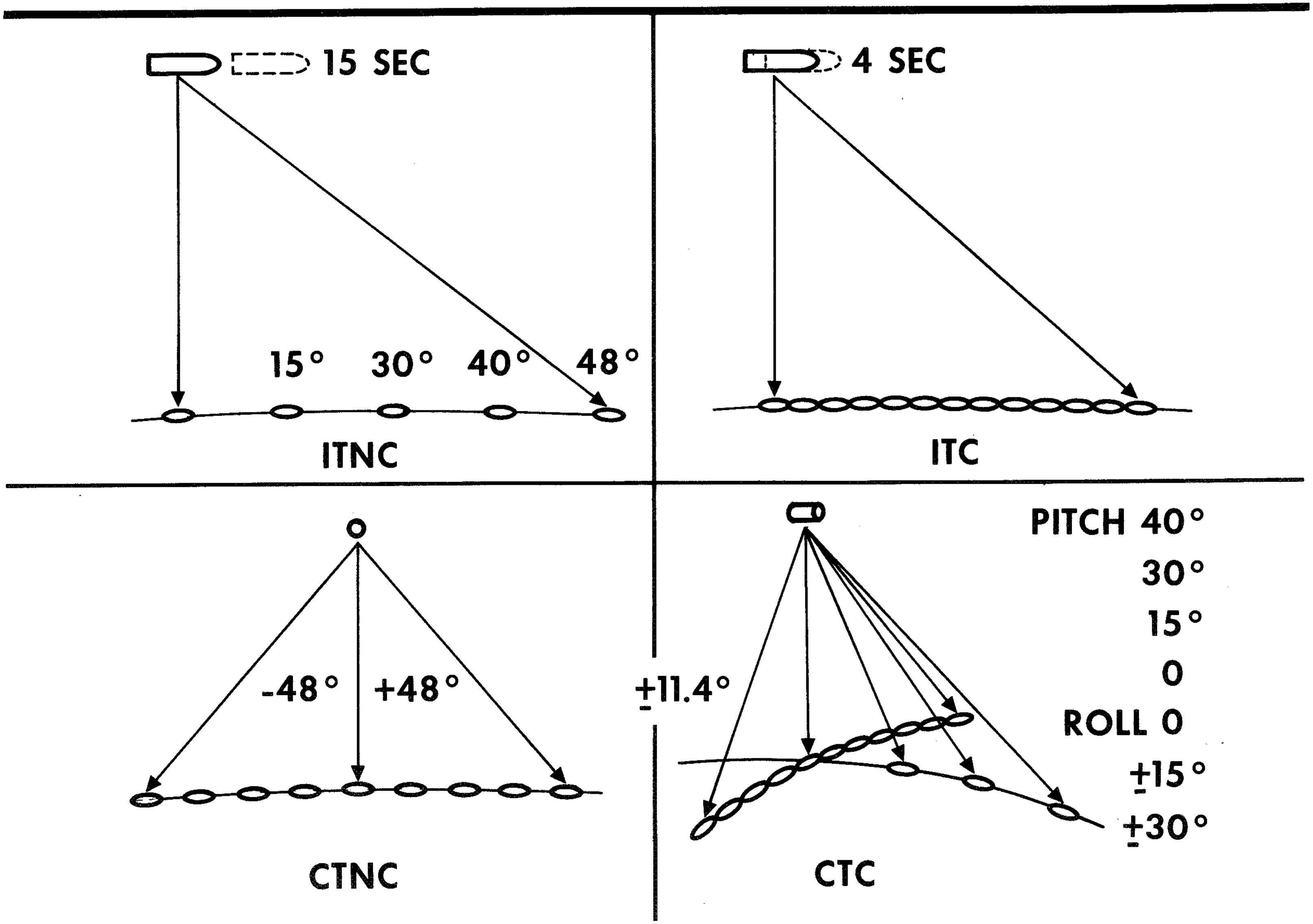
S193 MICROWAVE SYSTEM
OBJECTIVES- RADSCAT

- SEA STATE/WIND VELOCITY
- WEATHER PREDICTION
- CLOUDS AND RAIN
- SNOW, ICE COVER
- FLOODING, RAINFALL
- AGRICULTURE, GEOLOGY
- INSTRUMENT

NASA-S-71-13268-S

S193 MICROWAVE SYSTEM

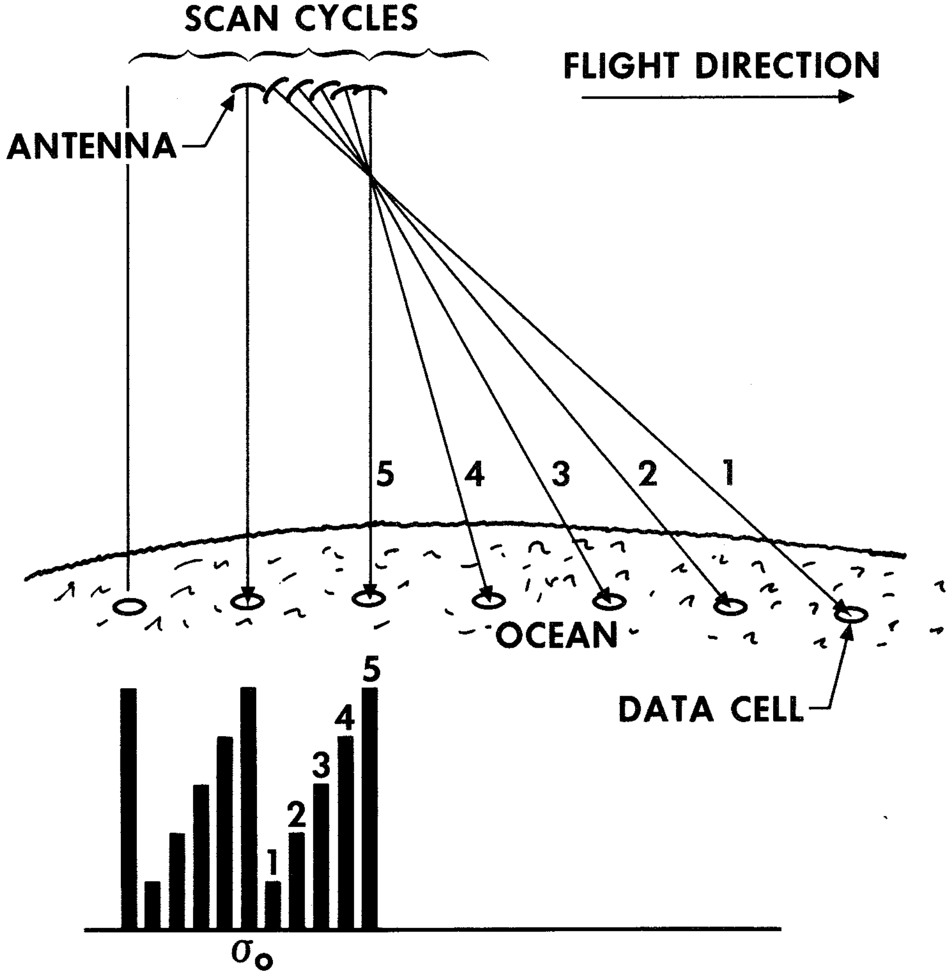
RADSCAT SCAN MODES



NASA-S-71-13250-S

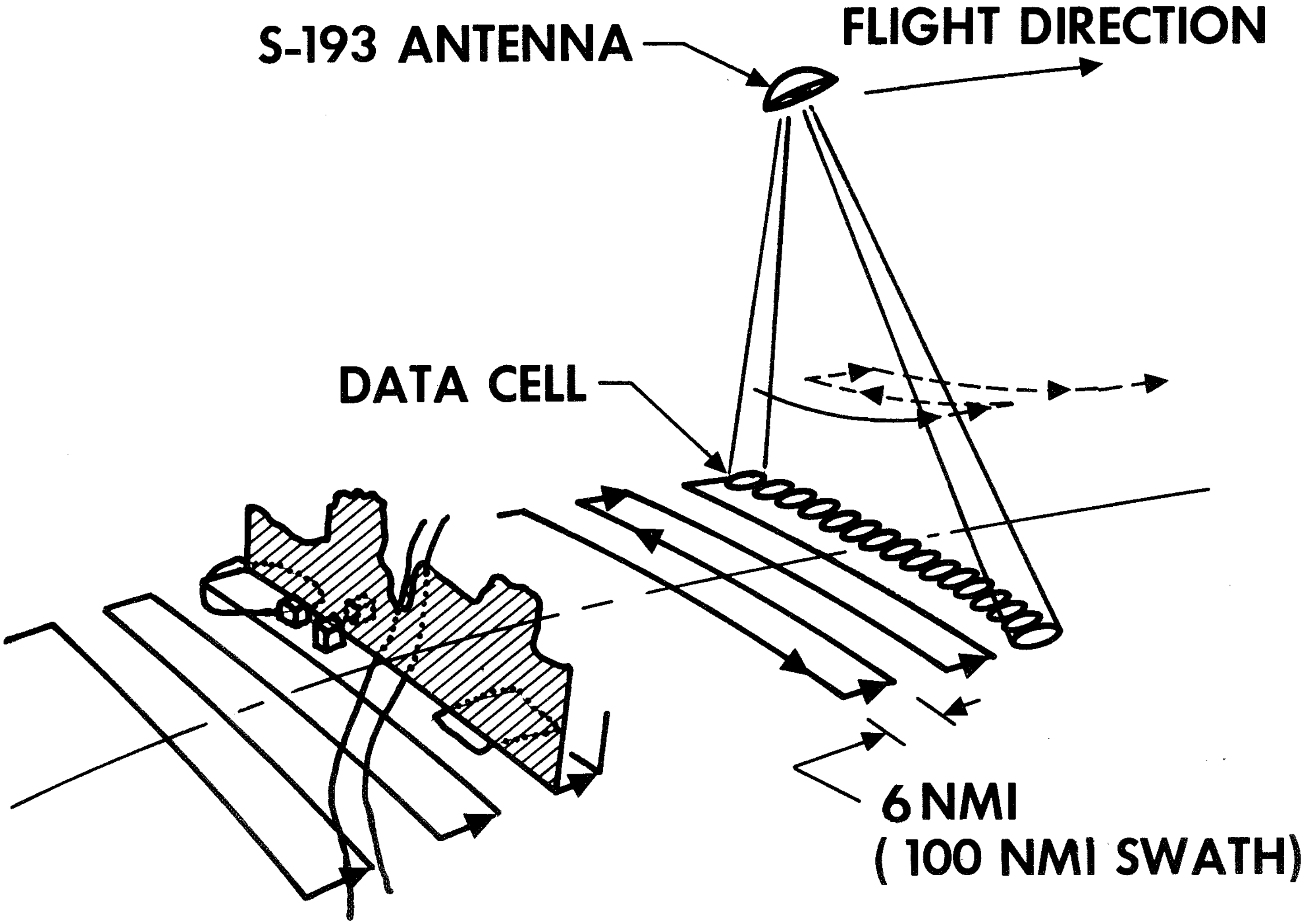
S193 MICROWAVE SYSTEM

RADIOMETER-SCATTEROMETER OPERATION IN IN-TRACK NON-CONTIGUOUS SCAN MODE



NASA-S-71-13249-S

S193 MICROWAVE SYSTEM CROSS-TRACK CONTIGUOUS MODE



NASA-S-71-13248-S

S193 MICROWAVE SYSTEM
OBJECTIVES - ALTIMETER

- PULSE SHAPE
- CROSS-SECTION
- PULSE SPACING
- PULSE COMPRESSION
- NADIR SEARCH
- OCEAN PROFILING
- SEA STATE

NASA-S-71-13247-S

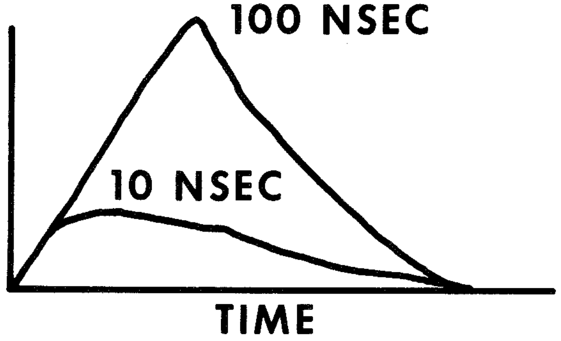
S193 MICROWAVE SYSTEM

ALTIMETER MODES

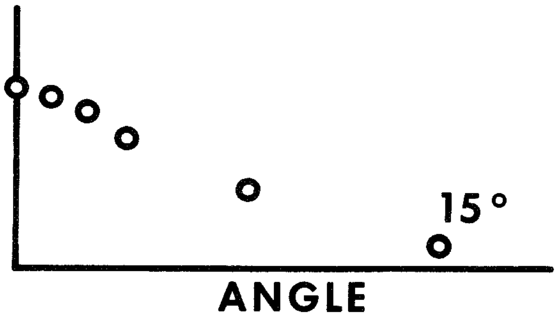
	PULSE SHAPE	BACK-SCATTER	TIME CORREL.	PULSE COMPR.	NADIR SEARCH
PULSE (NSEC)	10 100	100	10 100	130	100
SPACING	4 MSEC	4 MSEC	1—800 μSEC	4 MSEC	4 MSEC
GATES	8	NA	8	8	NA
DETECTION	SQLAW	→	→	→	→
ANGLE(DEG)	0, .5, 1.5	0 TO 15	0	0	0 TO 4

NASA-S-71-13245-S

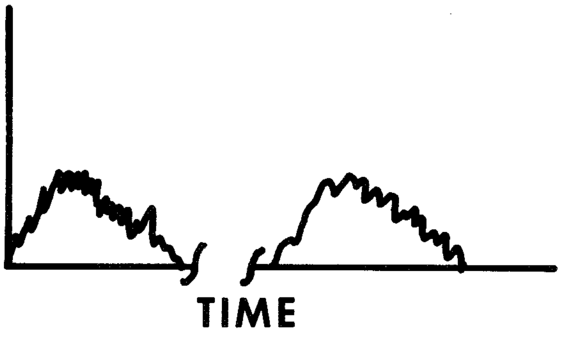
S193 MICROWAVE SYSTEM
PULSE SHAPES ALTIMETER



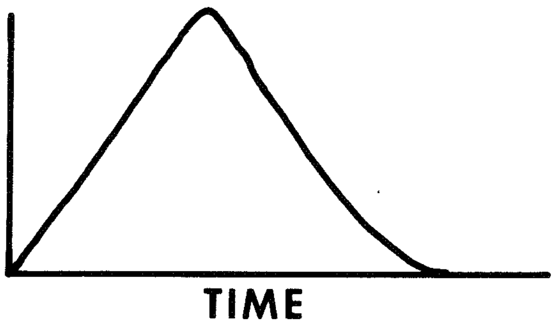
PULSE SHAPE



BACKSCATTER



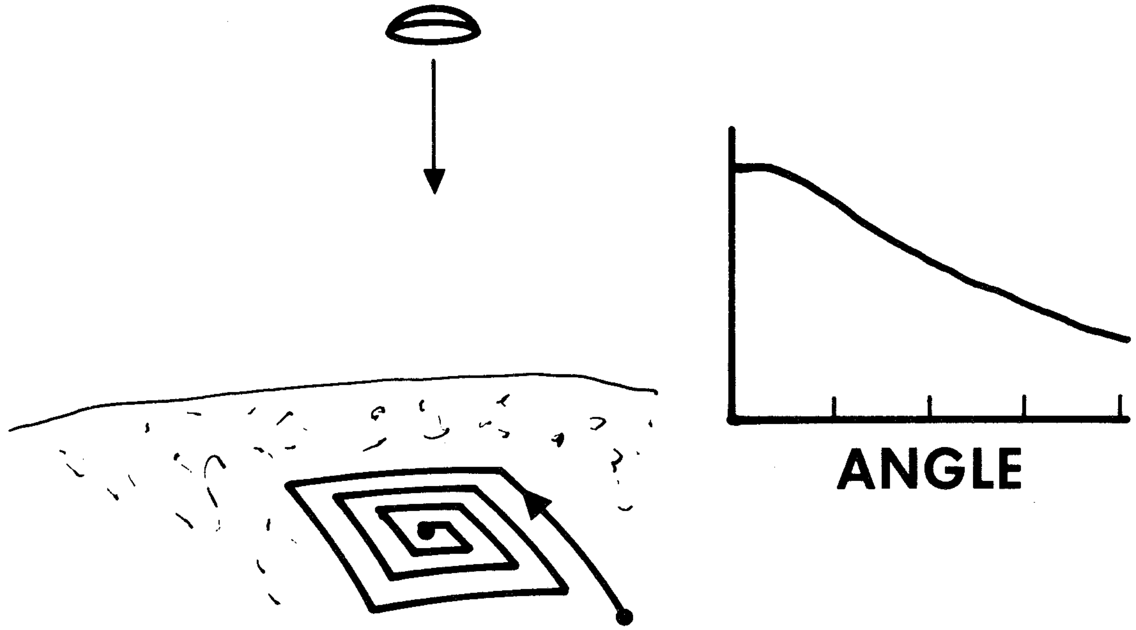
TIME CORRELATION



PULSE COMPRESSION

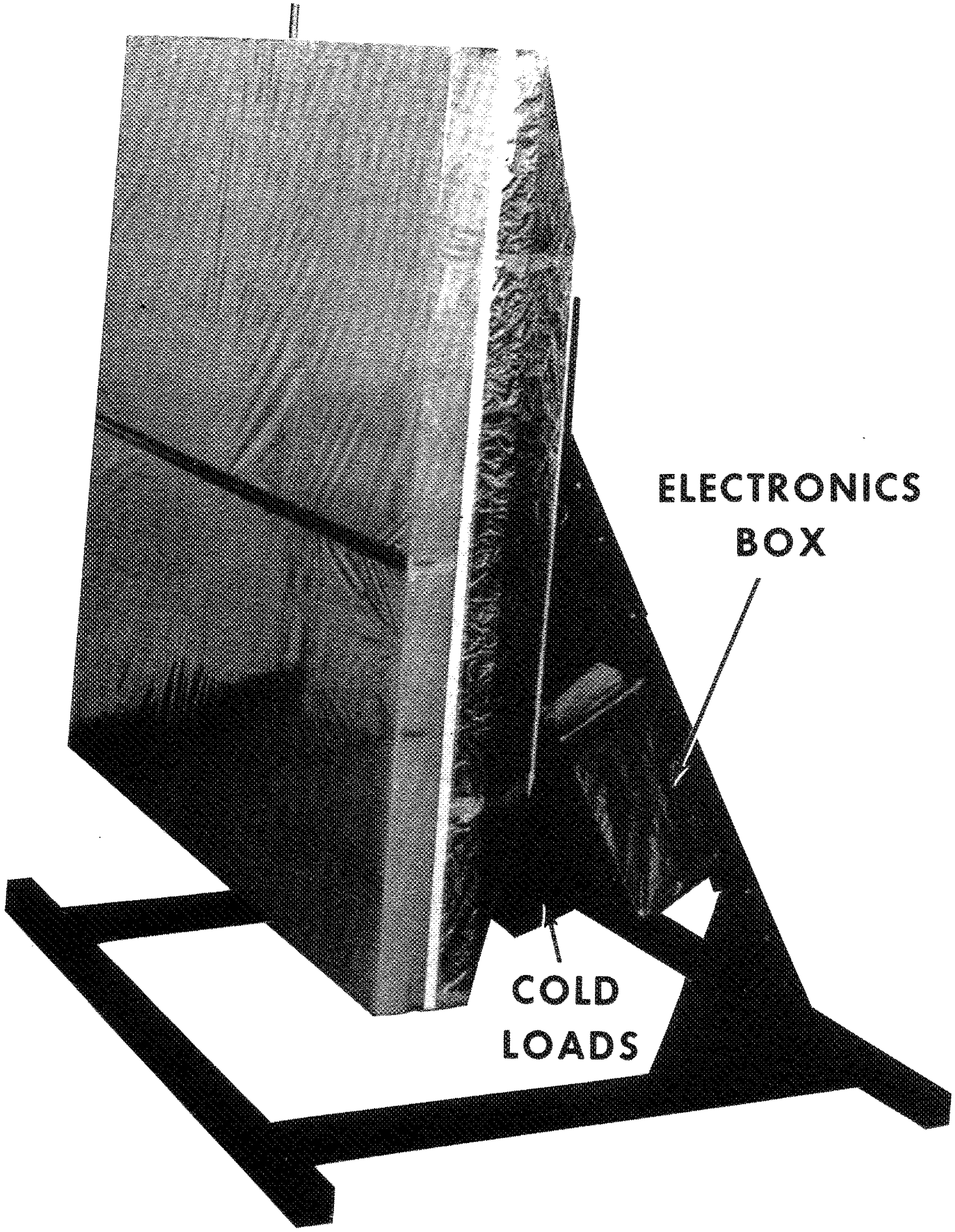
NASA-S-71-13246-S

S193 MICROWAVE SYSTEM NADIR SEEKER

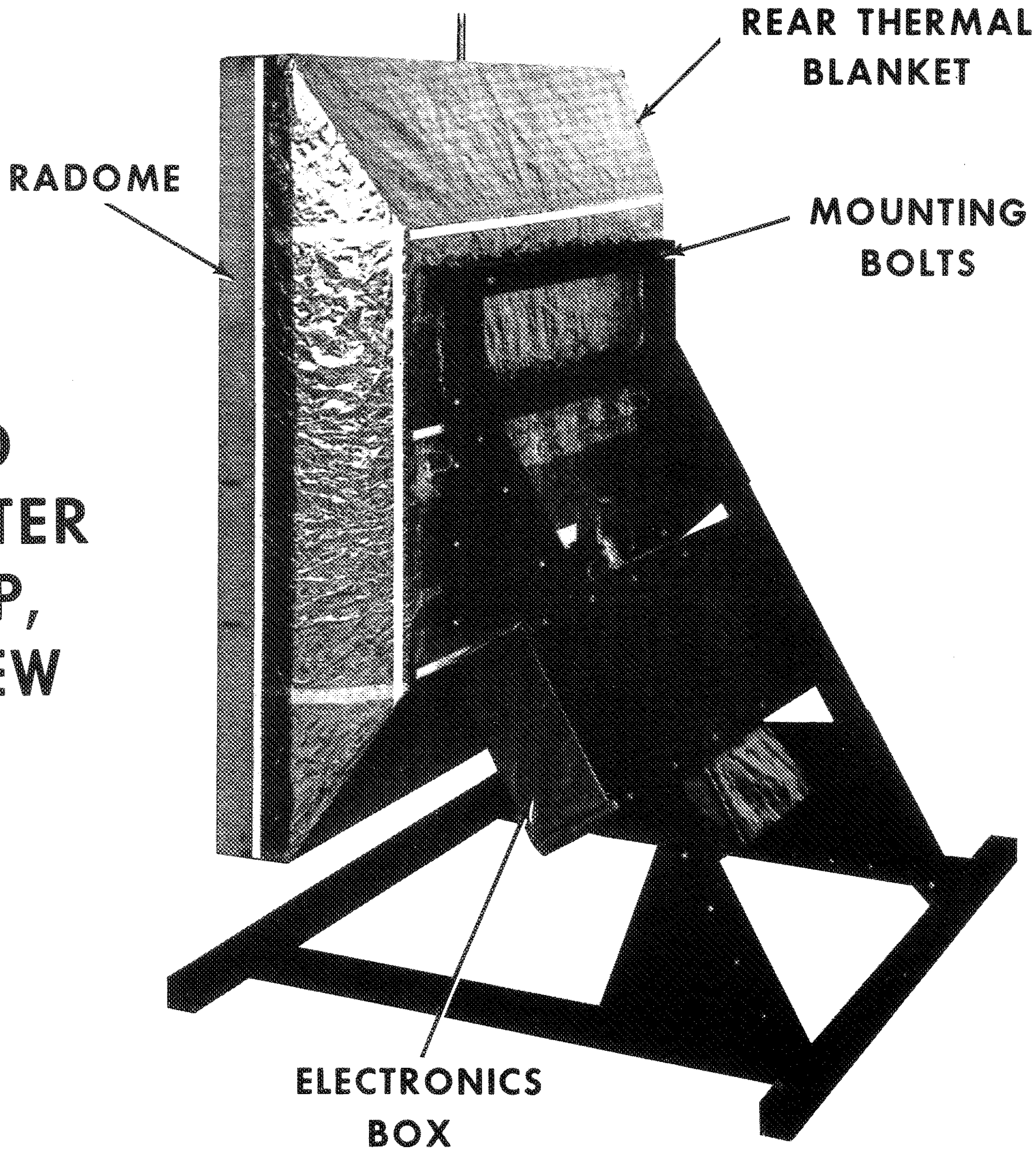


NASA-S-71-13255-S

S194 L-BAND RADIOMETER MOCKUP, FRONT VIEW

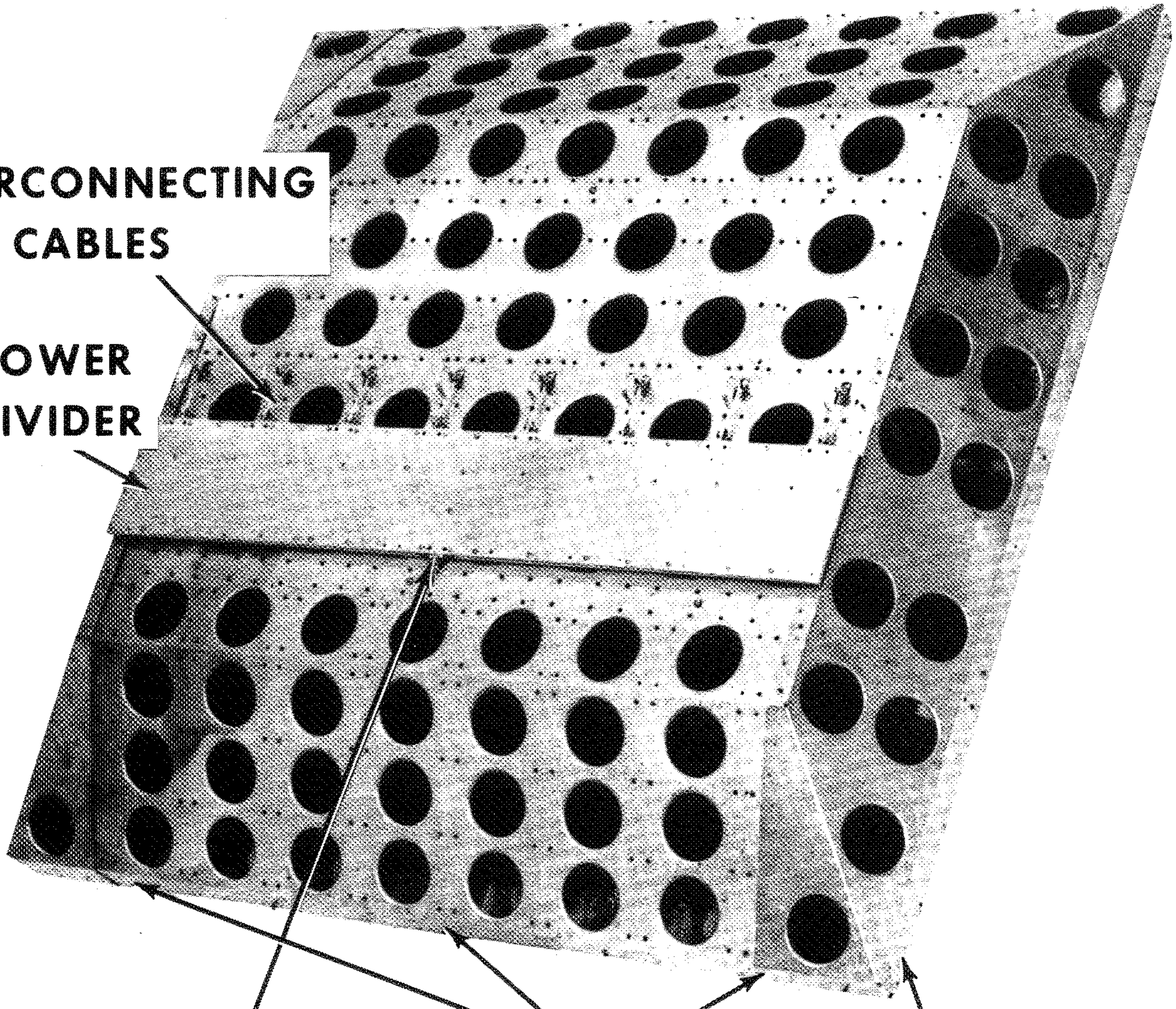


NASA-S-71-13258-S



S194
L-BAND
RADIOMETER
MOCKUP,
REAR VIEW

NASA-S-71-13257-S



ANTENNA VIBRATION TEST MODEL, REAR VIEW

S194 L-BAND RADIOMETER

NASA-S-71-13212-V

S194 L-BAND RADIOMETER

- DESCRIPTION
  - ABSOLUTE MICROWAVE-RADIOMETRIC SENSOR UTILIZING FIXED PLANAR ARRAY ANTENNA ORIENTED TOWARD NADIR
  - RECORDS THERMAL RADIATION IN THE MICROWAVE (L-BAND) RANGE
  - DIGITAL DATA OUTPUT GIVES ABSOLUTE ANTENNA TEMPERATURE TO ACCURACY OF 1° K
- PHYSICAL CHARACTERISTICS
  - DIMENSIONS
    - ANTENNA: 40 BY 40 BY 10.5 IN. 1 × 1 × 0.27 M
    - ELECTRONICS PACKAGE: 20 BY 10.5 BY 5.25 IN.
  - VOLUME
    - ANTENNA: 9.7 CU FT 0.27 M^3
    - ELECTRONICS PACKAGE: .6 CU FT 0.017 M^3
  - WEIGHT
    - ANTENNA: 31.5 LB 14.3 kg
    - ELECTRONICS: 16.0 LB 7.3 kg
  - POWER
    - OPERATE: 28 V DC, 15.0 W
    - SURVIVAL: 20.4 W CONTINUOUS
    - TOTAL OPERATING POWER: 35.4 W

S194 L-BAND RADIOMETER

- DESIGN FEATURES
  - RADIOMETER UTILIZING A CALIBRATION SCHEME REFERENCED TO A FIXED HOT AND COLD LOAD INPUT
- SPECTRAL CHARACTERISTICS
  - CENTER FREQUENCY: 1.4135 GHz
  - WAVELENGTH: 21 cm
  - BANDWIDTH: 27 MHz
- SPATIAL CHARACTERISTICS
  - BEAM WIDTH (HALF POWER): 15°
  - BEAM WIDTH (FIRST NULL): 36° (90 PERCENT OF POWER)
  - RESOLUTION (HALF POWER): 60-N MI DIAMETER CIRCLE

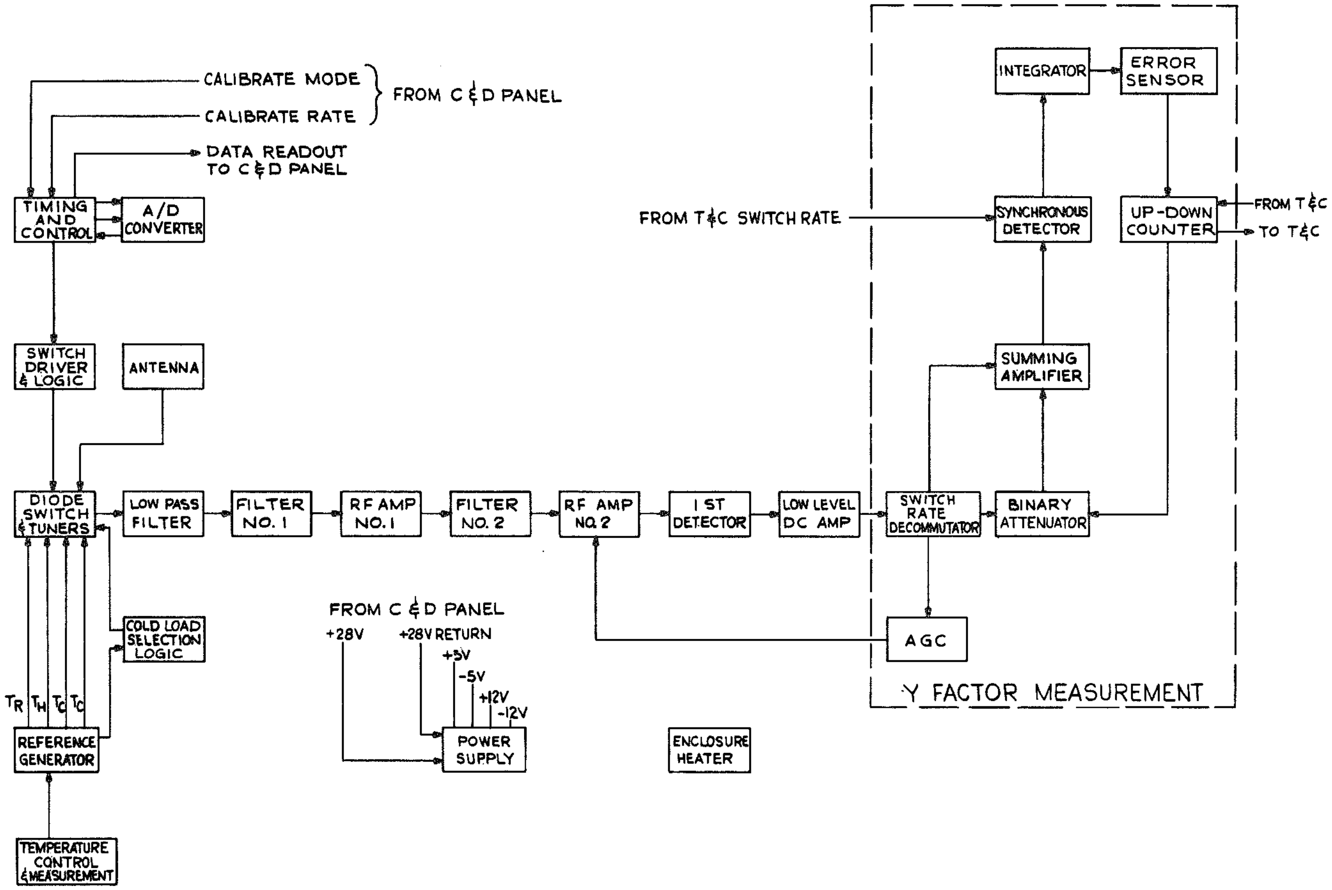
NASA-S-71-13236-V

S194 L-BAND RADIOMETER

- DATA CHARACTERISTICS
  - OUTPUT IS 18 TEN-BIT WORDS PCM-SIGNAL RECORDED ON MAGNETIC TAPE
- OPERATOR PARTICIPATION
  - TURNS EQUIPMENT ON AND OFF
  - INITIATES CALIBRATION SEQUENCE IN MANUAL MODE

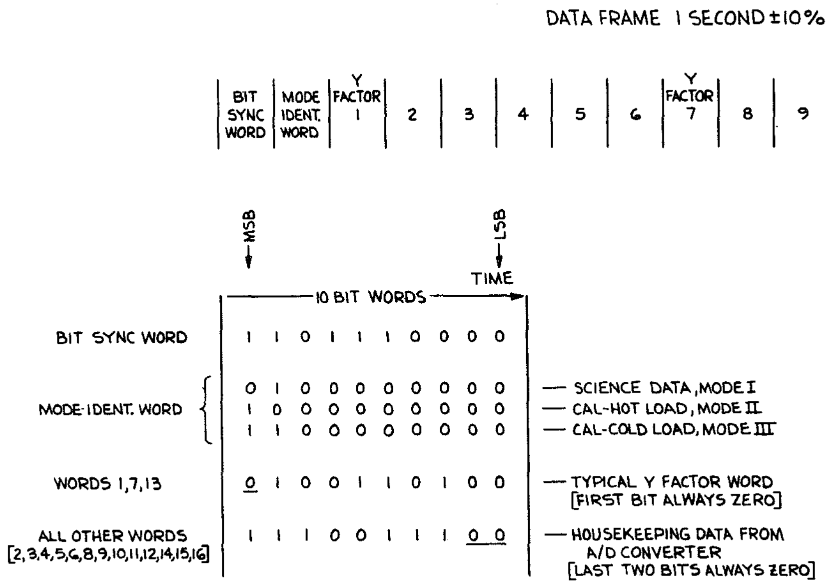
NASA-S-71-13190-V

S194 L-BAND RADIOMETER BLOCK DIAGRAM OF L-BAND RADIOMETER



NASA-S-71-13183-V

S194 L-BAND RADIOMETER DATA FORMAT



DATA FRAME 1 SECOND ±10%

BIT SYNC WORD	MODE IDENT. WORD	Y FACTOR 1	2	3	4	5	6	Y FACTOR 7	8	9	10	11	12	Y FACTOR 13	14	15	16

BIT SYNC WORD	1	1	0	1	1	1	0	0	0	0	
MODE IDENT. WORD	0	1	0	0	0	0	0	0	0	0	SCIENCE DATA, MODE I
	1	0	0	0	0	0	0	0	0	0	CAL-HOT LOAD, MODE II
	1	1	0	0	0	0	0	0	0	0	CAL-COLD LOAD, MODE III
WORDS 1,7,13	0	1	0	0	1	1	0	1	0	0	TYPICAL Y FACTOR WORD [FIRST BIT ALWAYS ZERO]
ALL OTHER WORDS [2,3,4,5,6,8,9,10,11,12,14,15,16]	1	1	1	0	0	1	1	1	0	0	HOUSEKEEPING DATA FROM A/D CONVERTER [LAST TWO BITS ALWAYS ZERO]

BIT RATE 180 Hz ± 4 Hz
ALL WORDS ARE 10 BITS IN DURATION [1/18 SEC ± 2%]
FRAME IS 1 SECOND ± 2% IN DURATION
DATA READOUT IS NRZ-L FORMAT

CALIBRATION, MODES II AND III EACH HAVE DURATIONS OF 16 SECS.
INTIATED BY: (A) POWER TURN-ON
(B) MANUAL CALIBRATE MOMENTARY CONTACT
(C) AUTOMATIC CALIBRATION — 4 OR 34 MINUTE INTERVAL

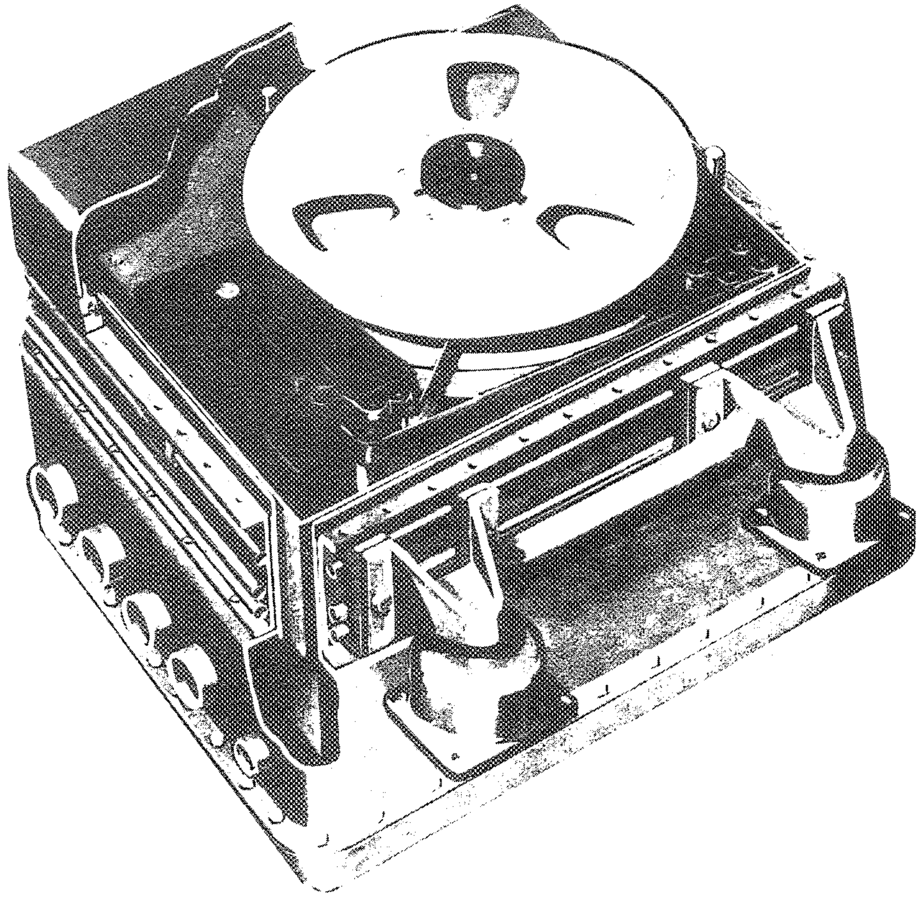
NASA-S-71-12603-V

EREP SUPPORT EQUIPMENT

EQUIPMENT	PURPOSE
ELECTRICAL/ELECTRONIC SYSTEM TAPE RECORDER SYSTEM CONTROL AND DISPLAY PANEL SUPPORTING RACKS	TO DISTRIBUTE AND CONTROL POWER TO EREP SENSORS; RECORD ON MAGNETIC TAPE EREP SCIENTIFIC AND HOUSEKEEPING DATA, ASTRONAUT VOICE COMMENTS, AND AM TIMING; PROVIDE ASTRONAUT MONITORING CAPABILITY FOR REAL-TIME DATA PARAMETERS FROM EREP SENSORS; PROVIDE STOWAGE OF EREP SUPPORT EQUIPMENT

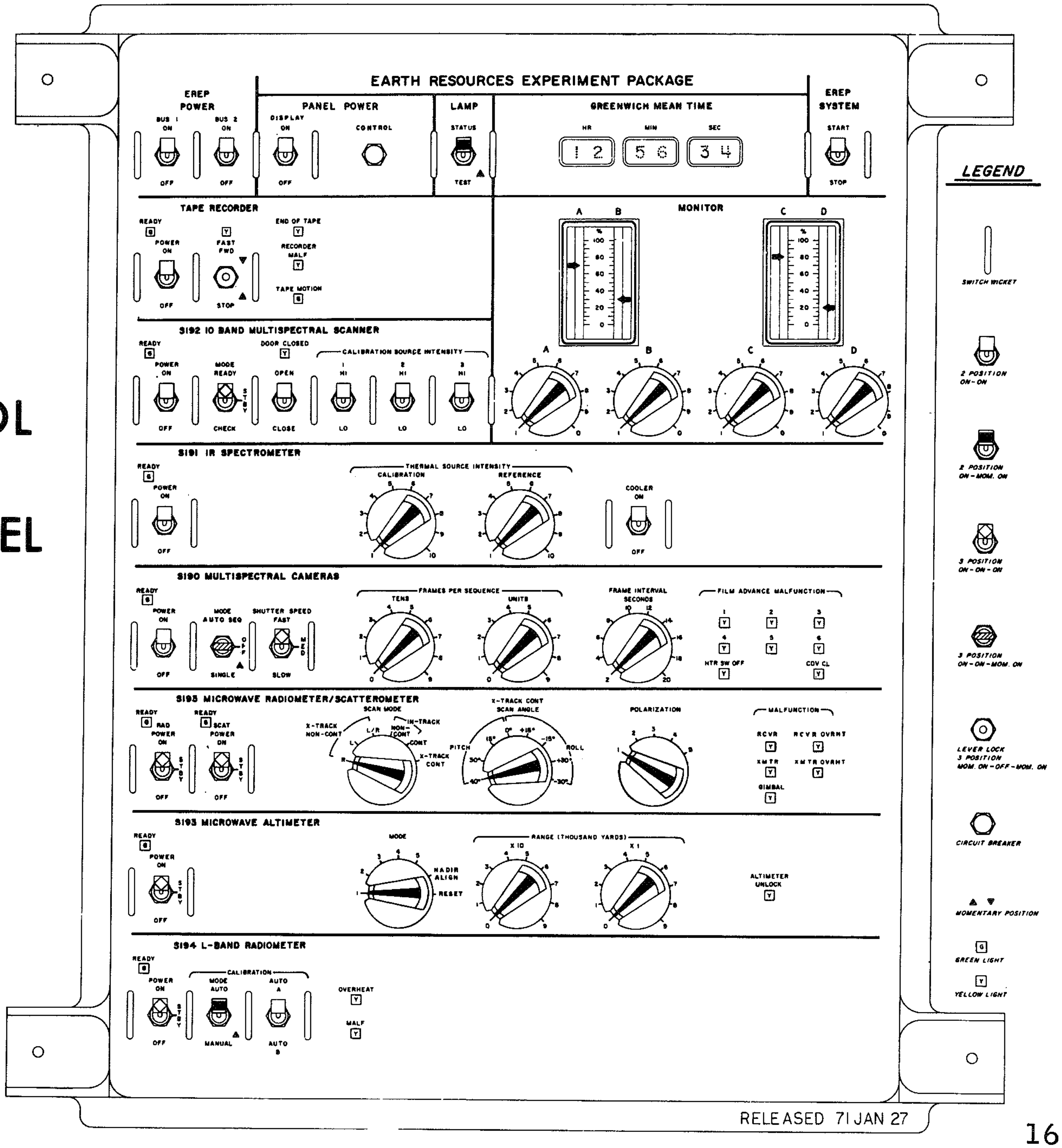
NASA-S-71-12618-V

TAPE RECORDER



NASA-S-71-13162-V

EREP CONTROL AND DISPLAY PANEL



Page intentionally left blank

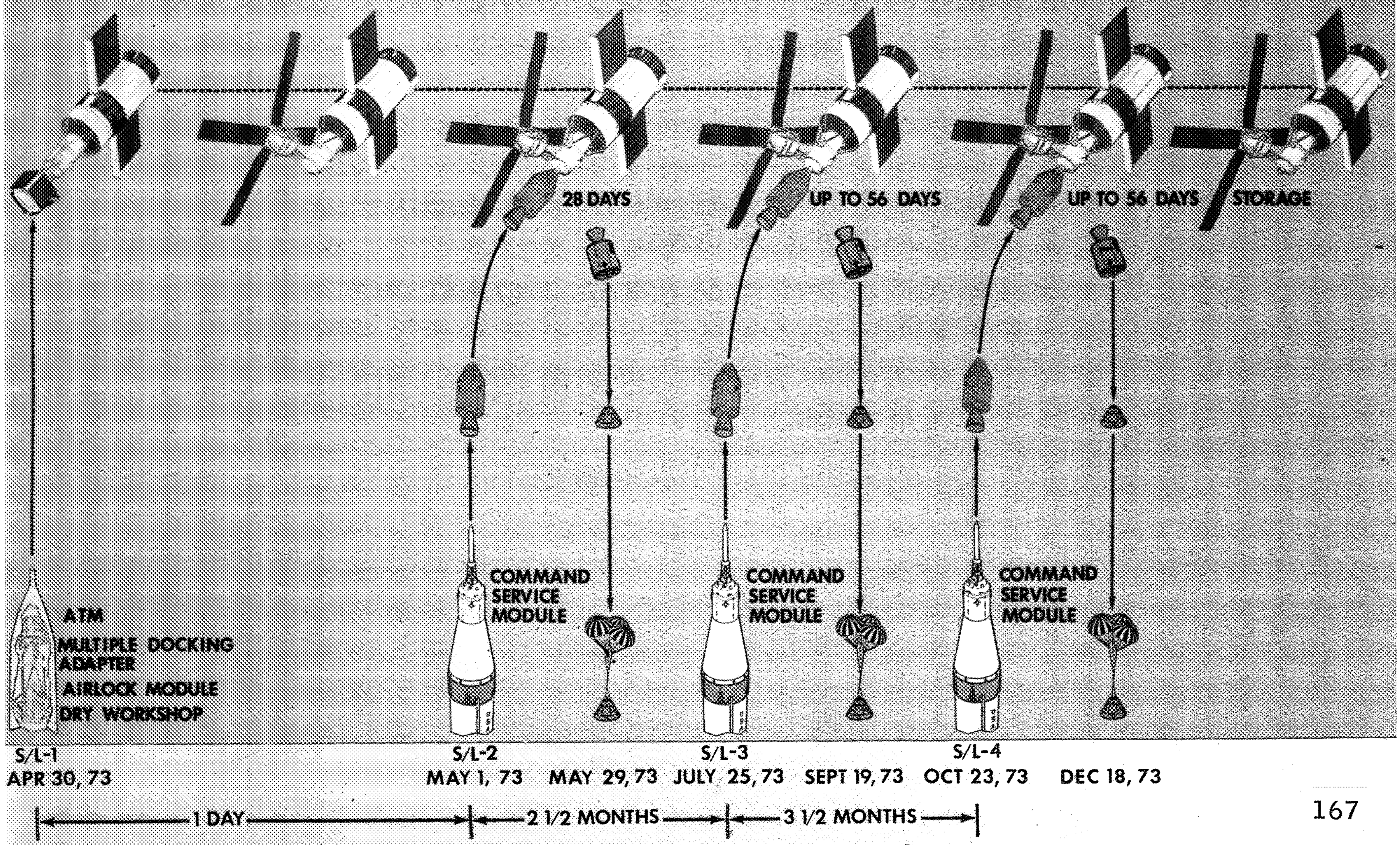
NASA-S-71-13265-V

MISSION PROFILE

Page intentionally left blank

NASA-S-71-13157-V

SATURN WORKSHOP ACTIVATION AND OPERATION



MISSION PROFILE REQUIREMENTS

- SKYLAB - 1/2
  - SL-1 INSERTED INTO A 235-N MI CIRCULAR ORBIT BY A TWO STAGE SATURN V
  - SL-1 TARGETED TO YIELD AN ORBITAL INCLINATION OF 50 DEG
  - SL-2 TARGETED FOR RENDEZVOUS WITH THE SL-1 WITHIN 5 TO 8 REVS AFTER INSERTION
  - SL-1/SL-2 MISSION DURATION PLANNED FOR 28 DAYS

MISSION PROFILE REQUIREMENTS (CONT)

- SKYLAB - 1/3 AND 1/4
  - SL-3 AND SL-4 LAUNCHED ABOUT 90 DAYS AFTER THE INITIATION OF THE PREVIOUS MISSION
  - SL-3 AND SL-4 INSERTED INTO AN 81 BY 120 N MI ORBIT BY A SATURN 1B
  - SL-3 AND SL-4 TARGETED TO RENDEZVOUS WITH THE SL-1 SWS WITHIN 5 TO 8 REVS AFTER INSERTION
  - SL-3 AND SL-4 MISSION DURATION PLANNED FOR 56 DAYS

NASA-S-71-13315-V

MISSION PROFILE CONSIDERATIONS

- LIGHTING REQUIREMENTS FOR LAUNCH AND RECOVERY
- ORBITAL LIGHTING
- MISSION INTERVALS
- RENDEZVOUS PROFILE
- LAUNCH ABORTS
- ATTITUDE AND POINTING REQUIREMENTS
- BACKUP AND CONTINGENCY PLANNING

NASA-S-71-13314-V

SELECTION OF SKYLAB LIFT-OFF TIMES

(APRIL 30, 1973, LAUNCH DATE)

- MANDATORY
  - DAYLIGHT IN RECOVERY AREA (1 HOUR PRIOR TO SUNRISE, 2 HOURS PRIOR TO SUNSET)
  - EARLY RENDEZVOUS REQUIRED ON SL-2 [PROVIDE FOR 5-DAY SLIP (2 HOURS EARLIER LAUNCH)]
  - 90-DAY NOMINAL LAUNCH INTERVAL (84-DAY MINIMUM)
  - SL-1 LAUNCH WINDOW OF AT LEAST 1 1/2 HOURS
- HIGHLY DESIRABLE
  - DAYLIGHT IN NORTH ATLANTIC LAUNCH ABORT AREAS [LAND NO LATER THAN 5 HOURS PRIOR TO SUNSET TO SATISFY A/C ACCESS TIME (4 HOURS) AND FLOTATION COLLAR ATTACHMENT (1 HOUR)]
  - EARLY RENDEZVOUS FOR SL-3 AND SL-4
  - USE EITHER MID-PACIFIC OR WEST ATLANTIC RECOVERY ZONE
- DESIRABLE
  - POSTRETROFIRE TRACKING
  - AVOID 100 PERCENT ORBITAL LIGHTING FOR DEORBIT PLATFORM ALINEMENTS

NASA-S-71-13304-V

SKYLAB MISSION SCHEDULE

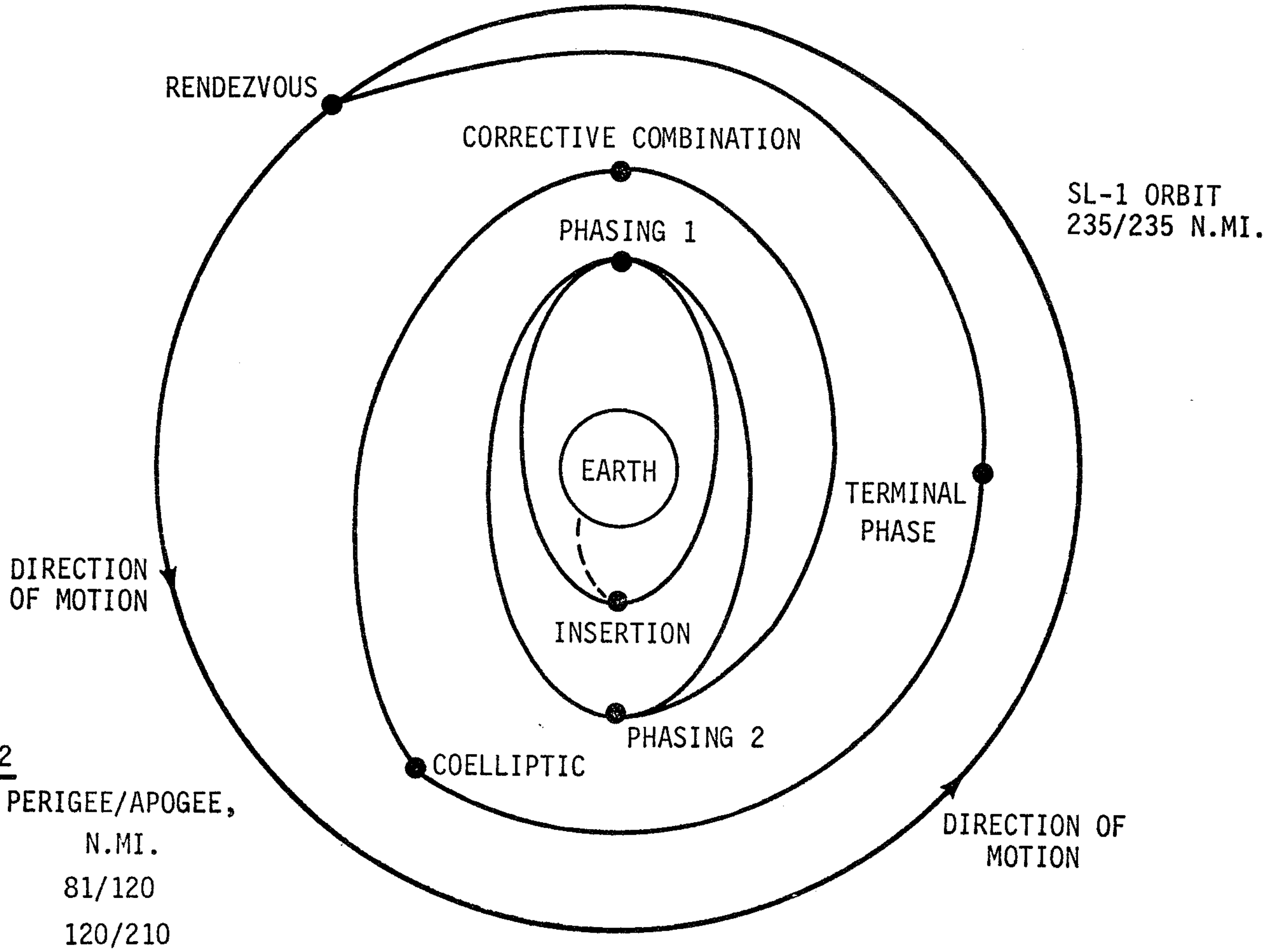
DATE	MISSION	LAUNCH TO LAUNCH CENTERS, DAYS	LIFT-OFF EASTERN STANDARD TIME	RECOVERY LOCAL STANDARD TIME	MAXIMUM PERCENT ORBITAL LIGHTING	RNDZ β ANGLE, DEG
APR 30	SL-1		10:30A			
MAY 1 TO MAY 29	SL-2	1 (57)[a]	10:00A (4:50A)[b]	ATLANTIC 7:00A (4:30A)[b]	69 (MAY 29)	-28
JULY 25 TO SEPT 19	SL-3	85 (34)	12 MIDNIGHT (4:45A)	ATLANTIC 9:00 (5:25A)	93 (AUG. 3)	42
OCT 23 TO DEC 18	SL-4	90	11:15A (5:45A)	PACIFIC 12 NOON (6:25A)	74 (DEC. 18)	43

[a] UNMANNED INTERVAL BETWEEN MISSIONS

[b] CIVIL TIME OF SUNRISE

NASA-S-70-3241-V

SKYLAB RENDEZVOUS SEQUENCE



SL-2

	PERIGEE/APOGEE, N.MI.
INSERTION	81/120
PHASING 1	120/210
PHASING 2	210/214
CORRECTIVE COMBINATION	214/225
COELLIPTIC	225/225
TERMINAL PHASE	225/235
RENDEZVOUS	235/235

NASA-S-71-13261-X

CONSTRAINTS AND GUIDELINES

- BETA ANGLE CONSTRAINTS
  - DEFINED AS ANGLE BETWEEN SOLAR VECTOR AND ORBIT PLANE AT SUBSOLAR POINT
  - NORMAL MODE IS SOLAR INERTIAL
  - EREP MODE IS Z LOCAL VERTICAL (ZLV)
  - ZLV REDUCES ATM SOLAR PANEL EFFICIENCY
  - ZLV EXPOSES BATTERY AND OTHER COMPONENTS TO DIRECT SUN LIGHT
  - ZLV CHANGES OVERALL THERMAL ENVIRONMENT OF THE CLUSTER
  - BETA ANGLE IS CONSTRAINED TO WITHIN ± 50 DEG DUE TO THE ABOVE

NASA-S-71-13188-X

CONSTRAINTS AND GUIDELINES (CONT)

- CONSTRAINT ON NUMBER OF EREP PASSES
  - ZLV ATTITUDE IS MAINTAINED USING THE CMG'S
  - MANEUVERING TO AND/OR HOLDING ZLV ATTITUDE CAN BE ACCOMPLISHED BY USE OF THE THRUSTER ATTITUDE CONTROL SYSTEM
  - PRESENT PROFILE ALLOCATES 45 TOTAL EREP PASSES
  - NUMBER OF PASSES PER MISSION IS TO BE DETERMINED
  - EFFORTS WILL BE MADE TO RELAX THESE CONSTRAINTS DEPENDING ON ACTUAL REQUIREMENTS

NASA-S-71-13260-X

CONSTRAINTS AND GUIDELINES (CONT)

- SUN ANGLE GUIDELINES
  - GENERALLY S190 PHOTOGRAPHS WILL BE TAKEN AT SUN ANGLES GREATER THAN 20 DEG IN WINTER AND 30 DEG IN SUMMER
  - NO CONSTRAINT IS POSED ON SUNLIGHT FOR S190
  - S190 PHOTO REQUIREMENTS WILL BE SATISFIED PER THE SUN ANGLE REQUIREMENT IF POSSIBLE
- TAPE AND FILM
  - EREP DATA TAKING PER MISSION IS CONSTRAINED TO
  - 18 ROLLS OF FILM (4800 FRAMES COLOR, 2400 FRAMES B&W)
  - 1 ROLL OF 16 mm B&W FOR VTS (5600 FRAMES)
  - 4-28 TRACK MAG TAPE - 7200 FT EACH

NASA-S-71-12831-X

CONSTRAINTS AND GUIDELINES (CONT)

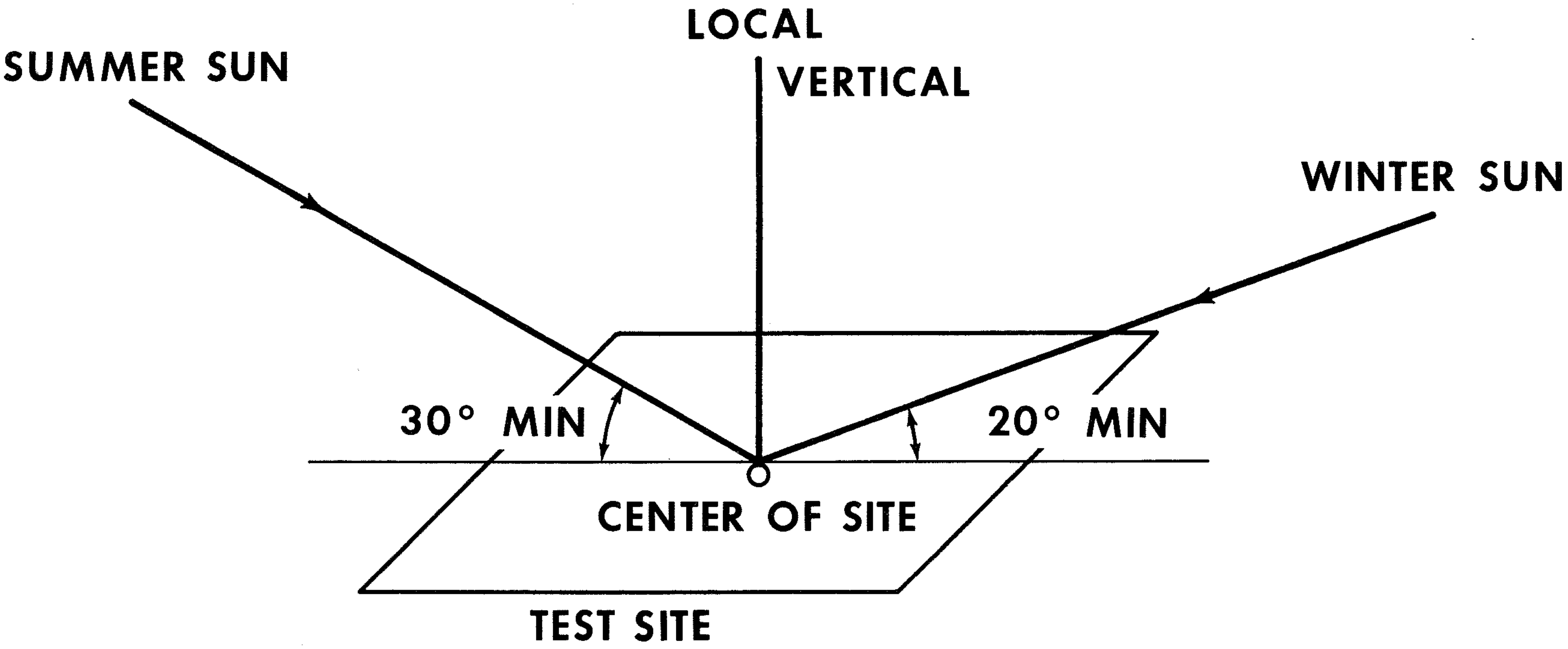
- EREP CREW CONSIDERATIONS
  - EREP WILL NOT GENERALLY BE SCHEDULED DURING 8 HR SLEEP PERIODS
  - EAT PERIODS MAY BE MOVED ± 1 HR
  - THE CREW WILL STUDY THE EREP TARGET MAPS AND PROCEDURES THE NIGHT BEFORE
  - GENERALLY, EREP PASSES WILL BE SCHEDULED TO UTILIZE TWO CREWMEN FOR EREP, ONE ON THE C&D PANEL AND ONE ON THE VTS
  - EREP PASSES WILL NOT REQUIRE GROUND COMMUNICATIONS DURING THE PASS
  - PRIME AND BACKUP PASSES WILL BE FLIGHT PLANNED

CONSTRAINTS AND GUIDELINES (CONT)

- TYPES OF EREP PASSES
  - 60 DEG OF ORBITAL TRAVEL POSITIONED WITHIN A 120 DEG ARC ABOUT ORBITAL NOON
  - 60 DEG PASS ANYWHERE IN ORBIT
  - 120 DEG PASS ANYWHERE IN ORBIT
  - THE NUMBER OF SUBSEQUENT SOLAR INERTIAL PERIODS AND CONSECUTIVE NUMBER OF PASSES IS UNDER STUDY BY MSFC FOR THERMAL AND ELECTRICAL IMPACT

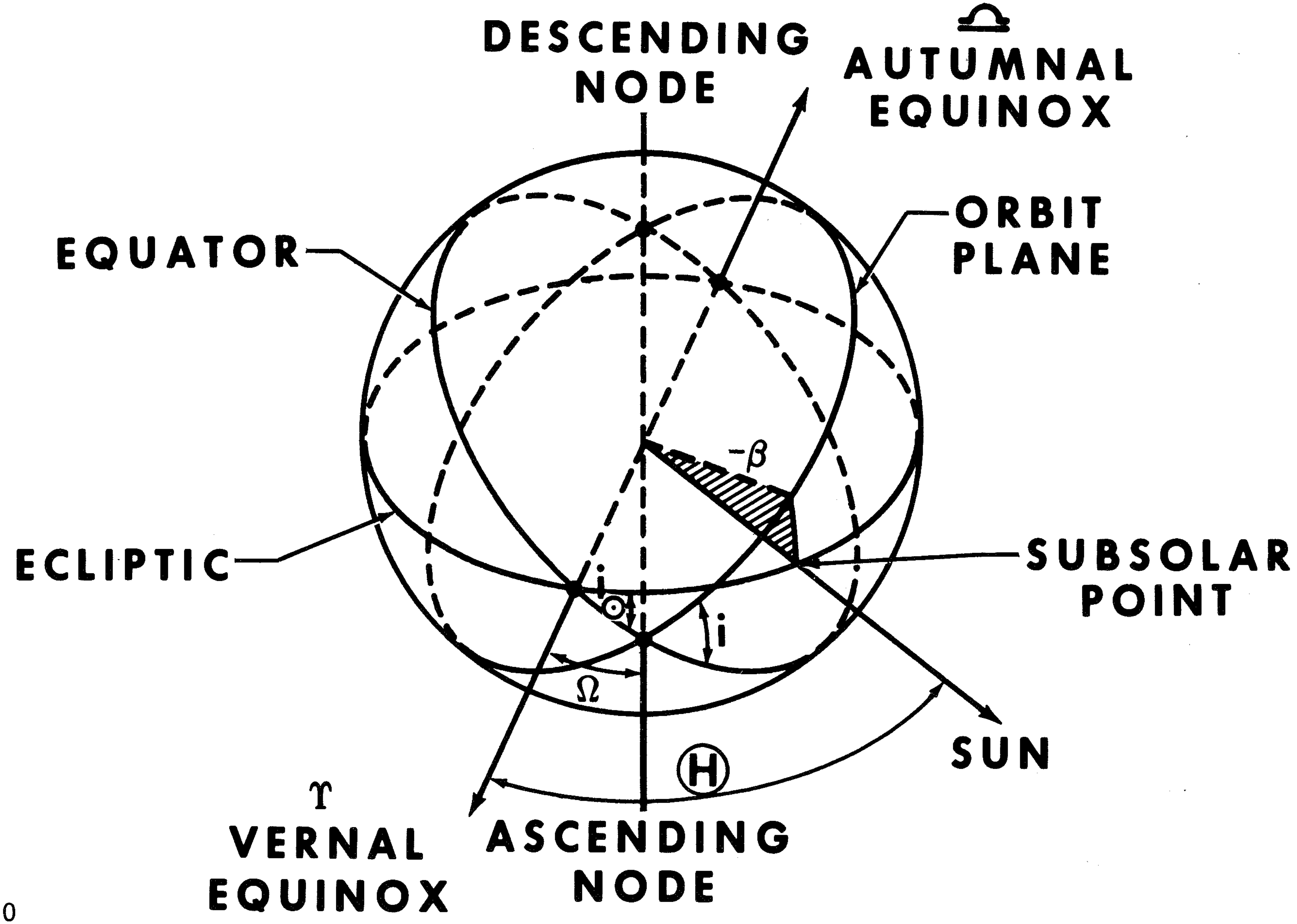
NASA-S-71-12507-S

SUN ANGLE OVER A TEST SITE



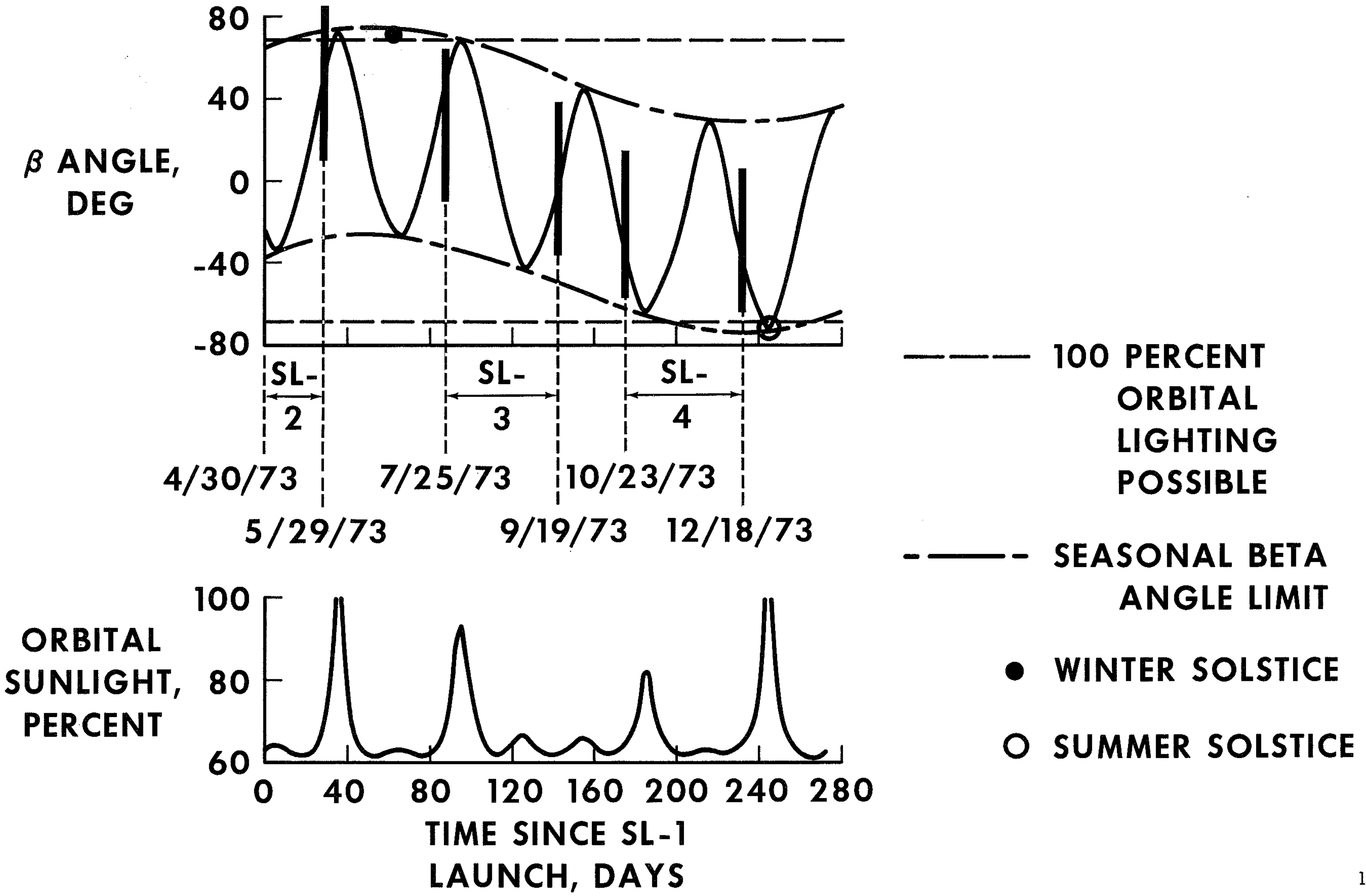
NASA-S-71-12646-S

BETA ANGLE GEOMETRY



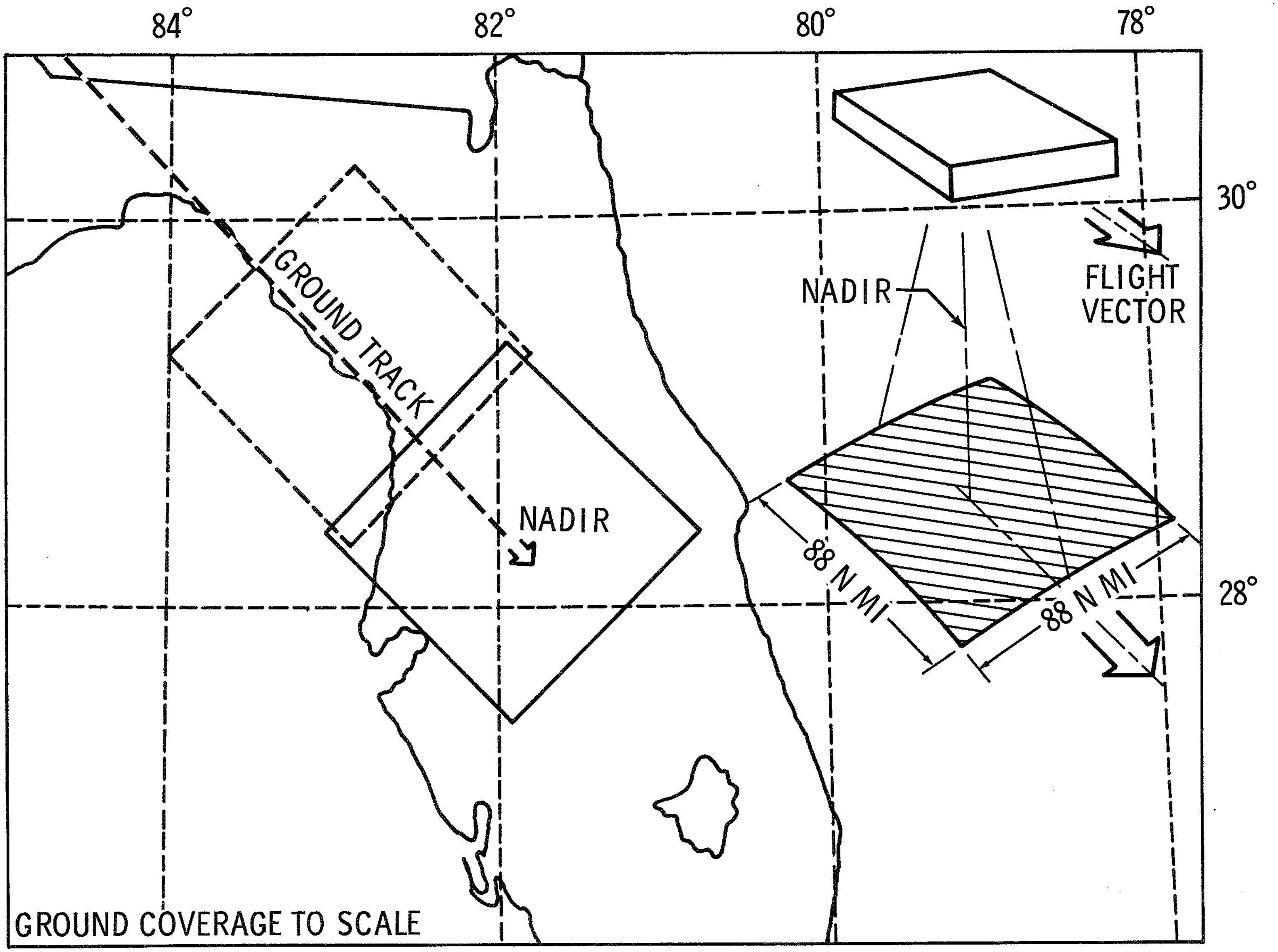
NASA-S-71-13320-S

BETA ANGLE TIME HISTORY AND ORBITAL SUNLIGHT PERCENT FOR 10:30 AM EST LAUNCH, 30 APRIL 1973



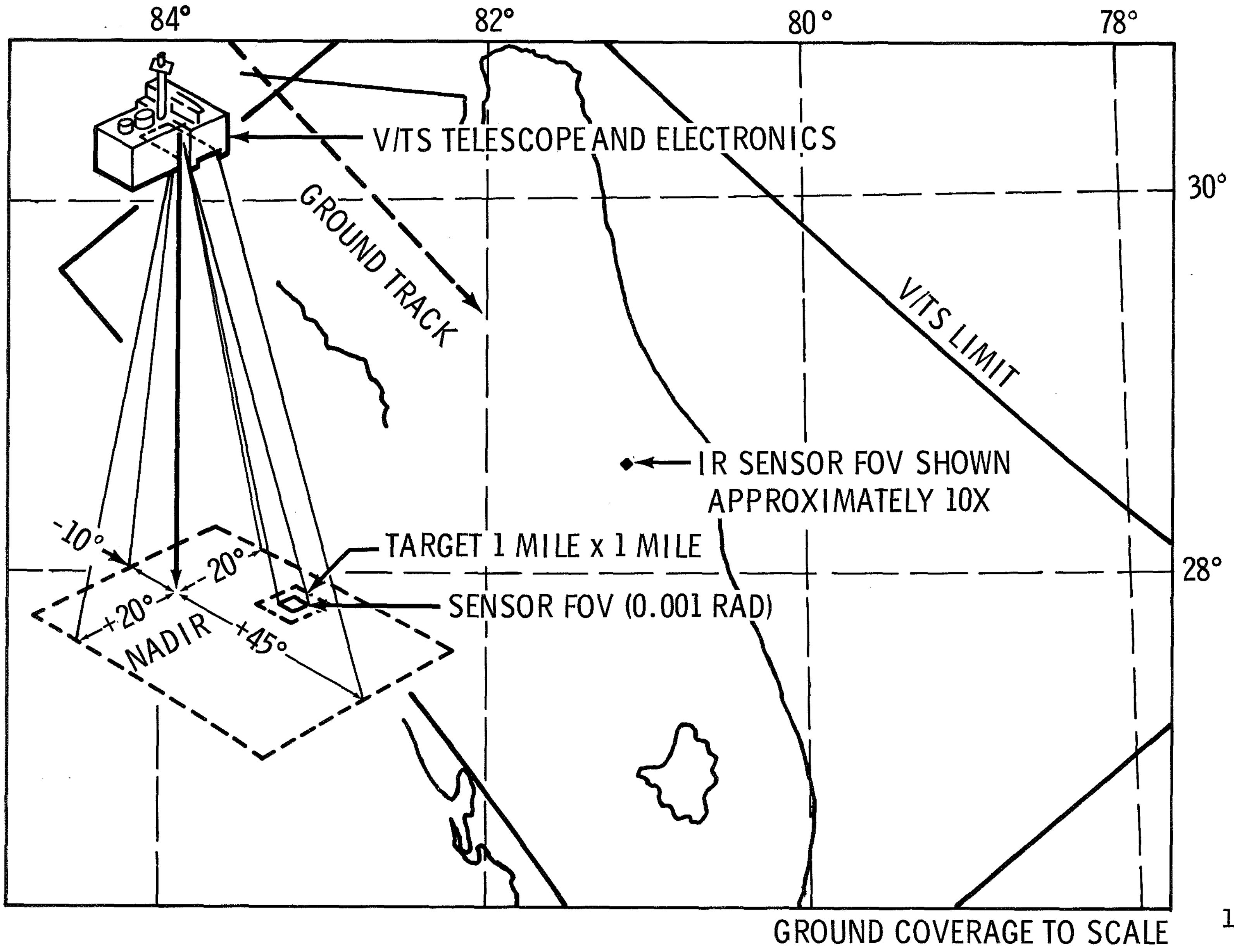
NASA-S-71-12729-V

S190 MULTISPECTRAL PHOTOGRAPHY GROUND CONVERAGE



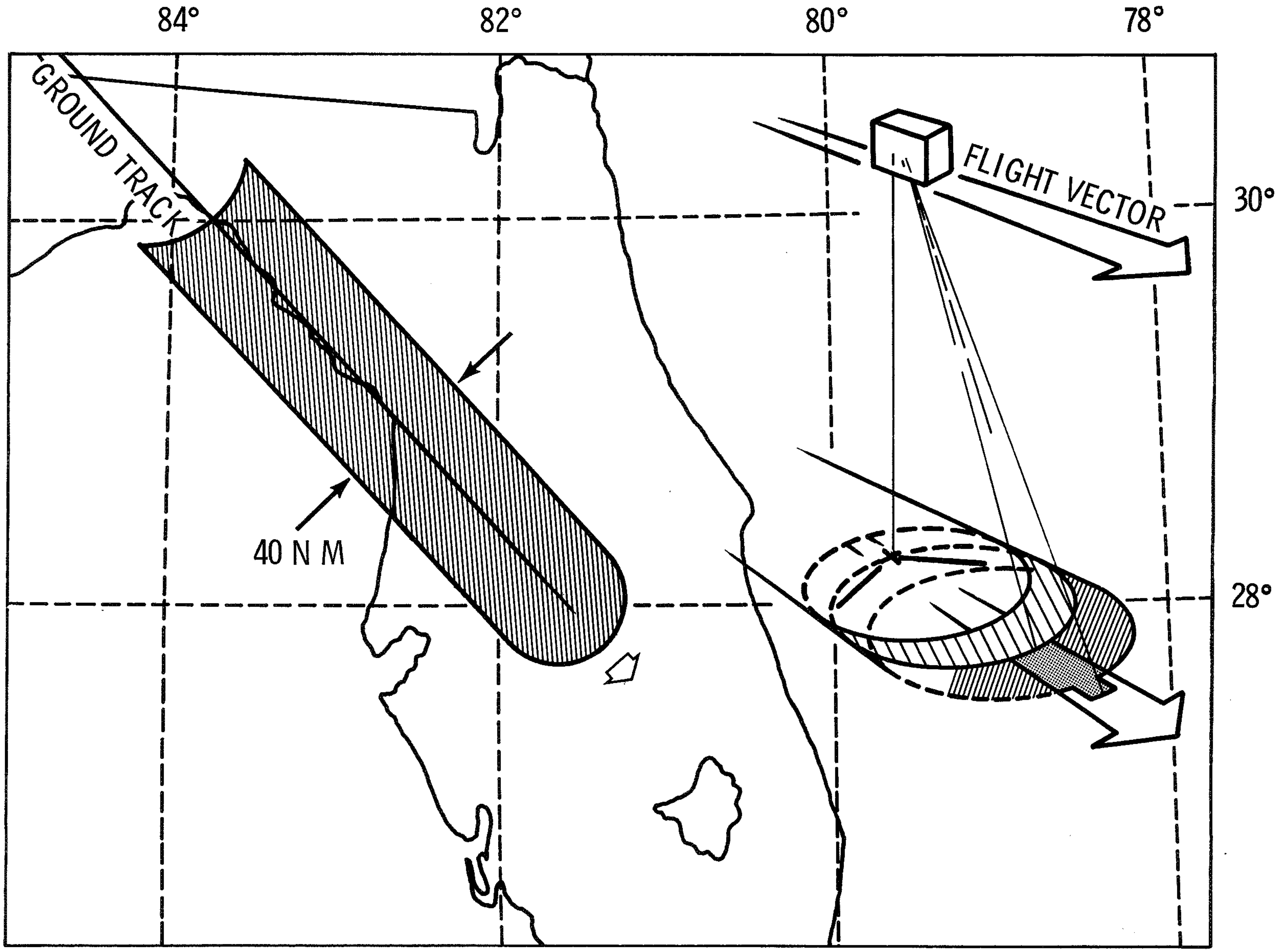
NASA-S-71-13241-V

S191 INFRARED SPECTROMETER, GROUND COVERAGE



NASA-S-71-12712-V

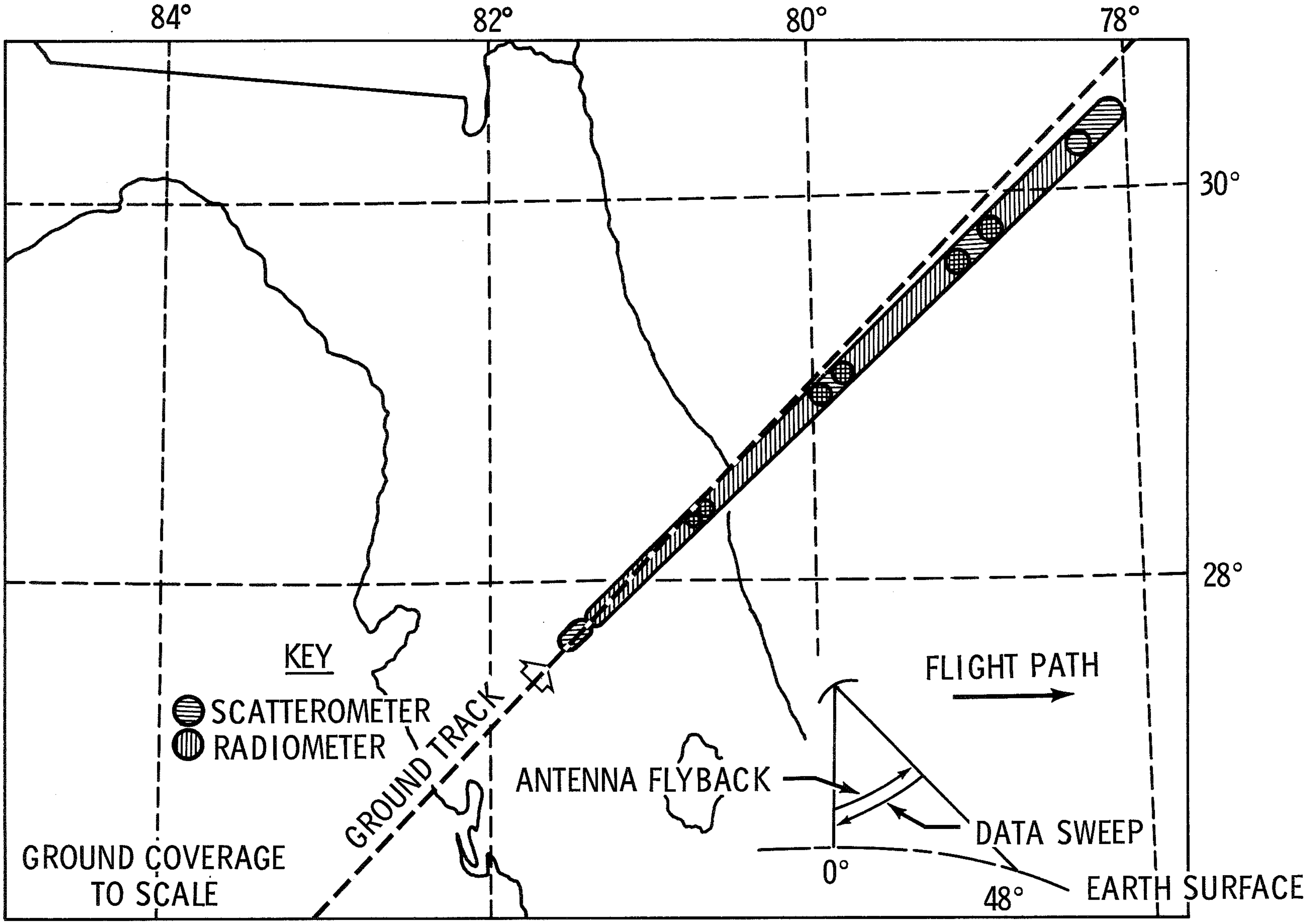
S192 MULTISPECTRAL SCANNER, GROUND COVERAGE



GROUND COVERAGE TO SCALE

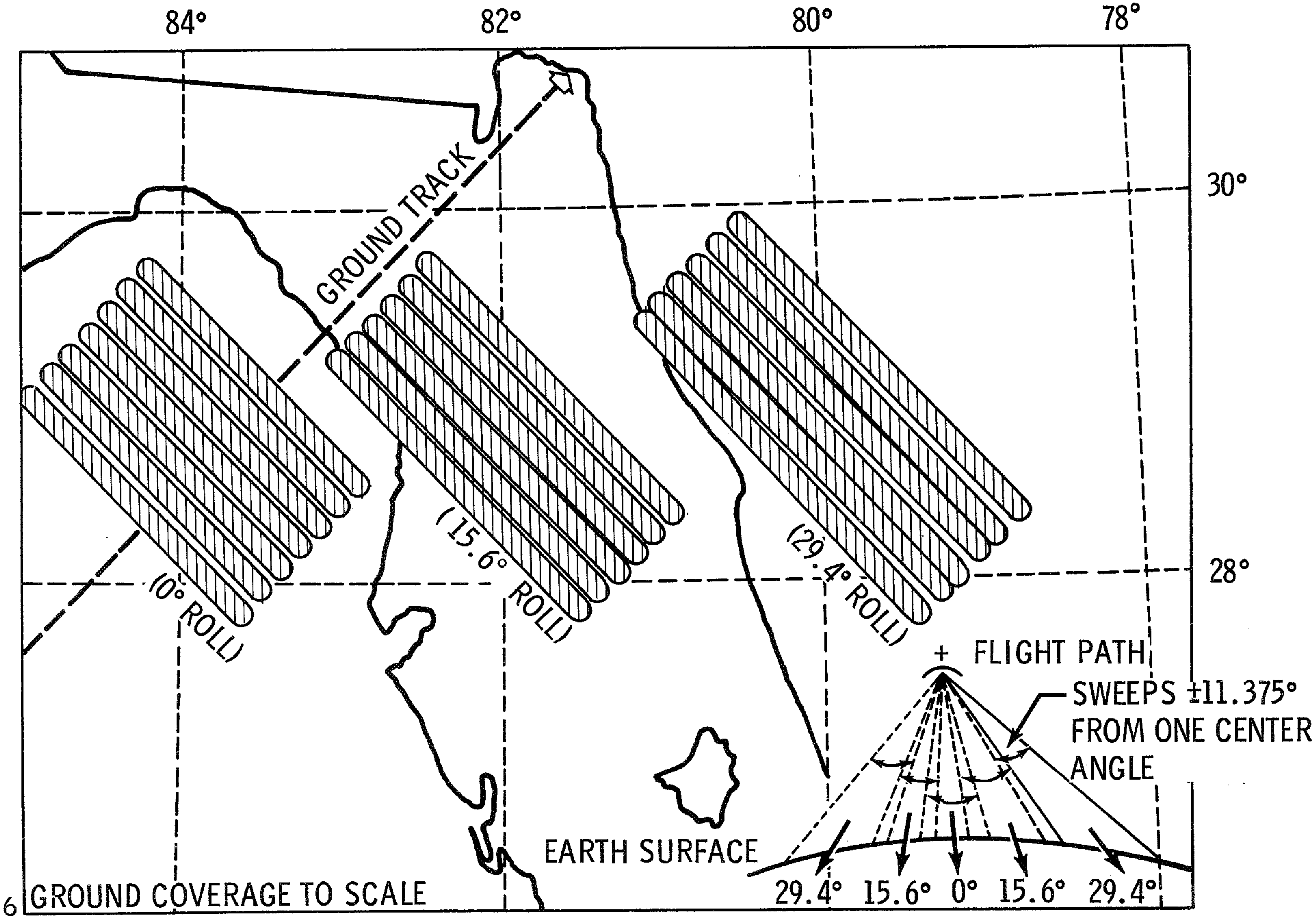
NASA-S-71-12711-V

S193 RADIOMETER/SCATTEROMETER, IN-TRACK CONTIGUOUS



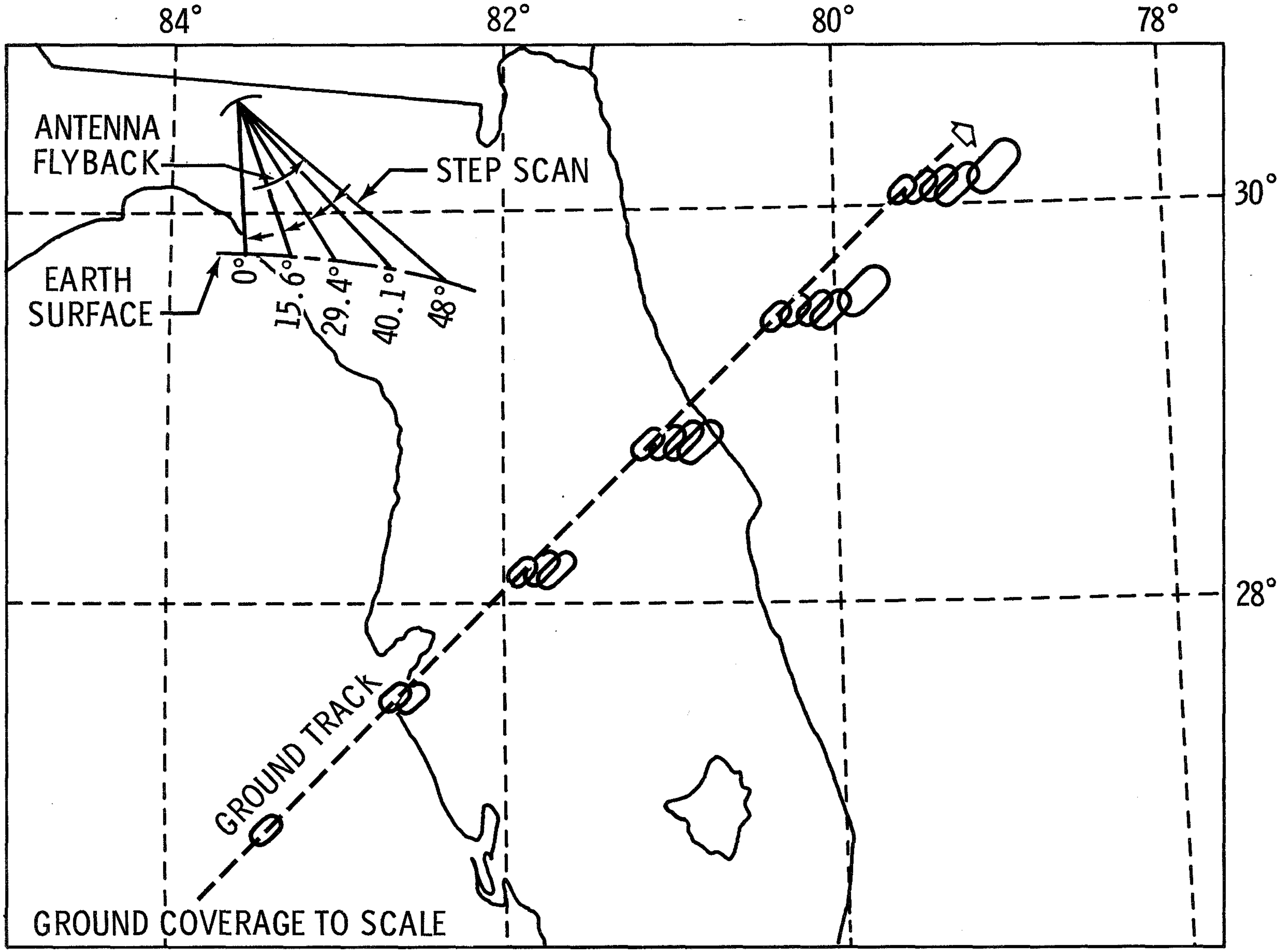
NASA-S-71-13240-V

S193 RADIOMETER/SCATTEROMETER, CROSS-TRACK CONTIGUOUS (0° ELEVATION ANGLE)



NASA-S-71-12705-V

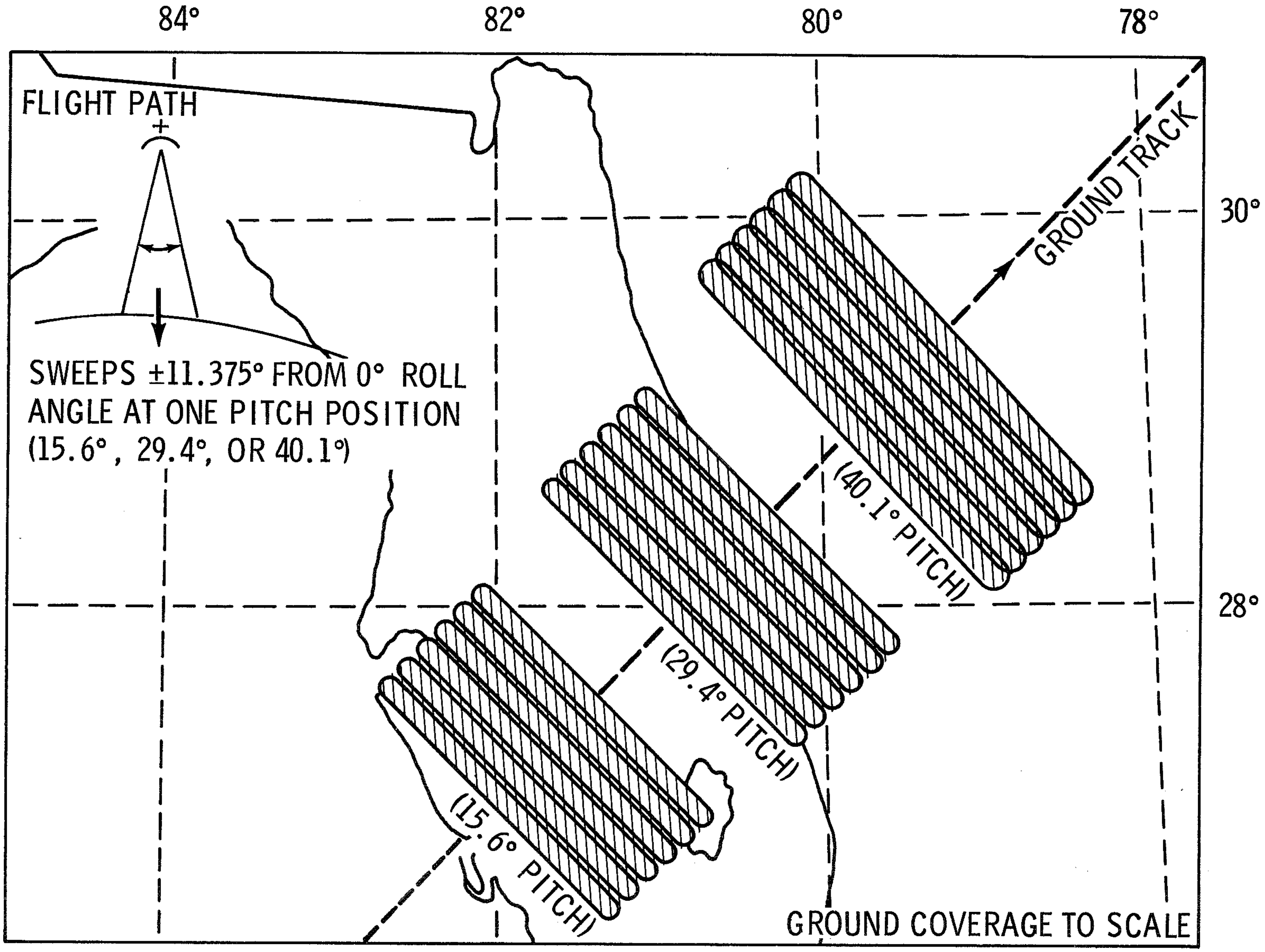
S193 RADIOMETER/SCATTEROMETER, IN-TRACK NON-CONTIGUOUS



NASA-S-71-12713-V

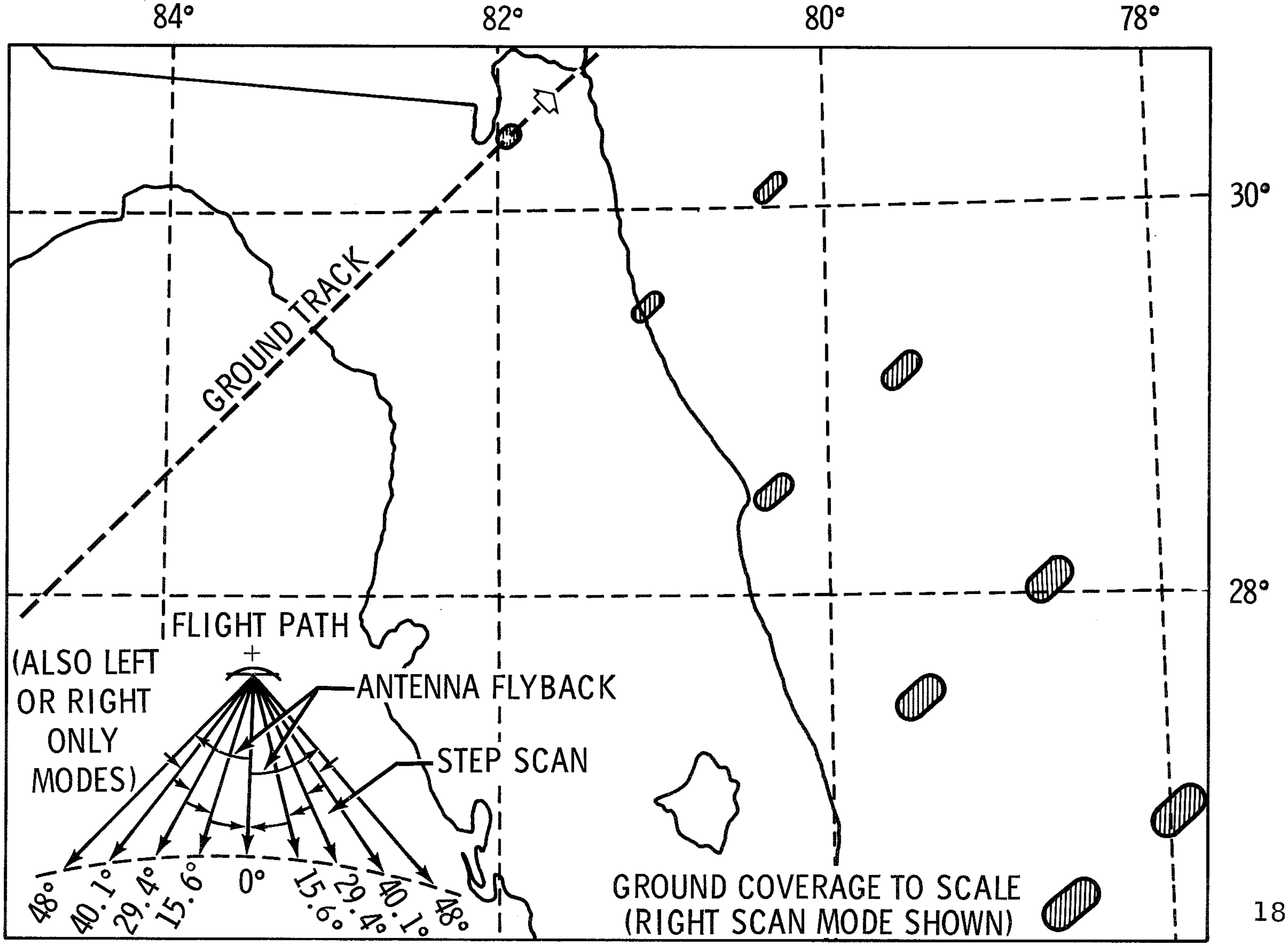
S-193 RADIOMETER/SCATTEROMETER, CROSS-TRACK CONTIGUOUS MODE

(NON-ZERO ELEVATION ANGLE)



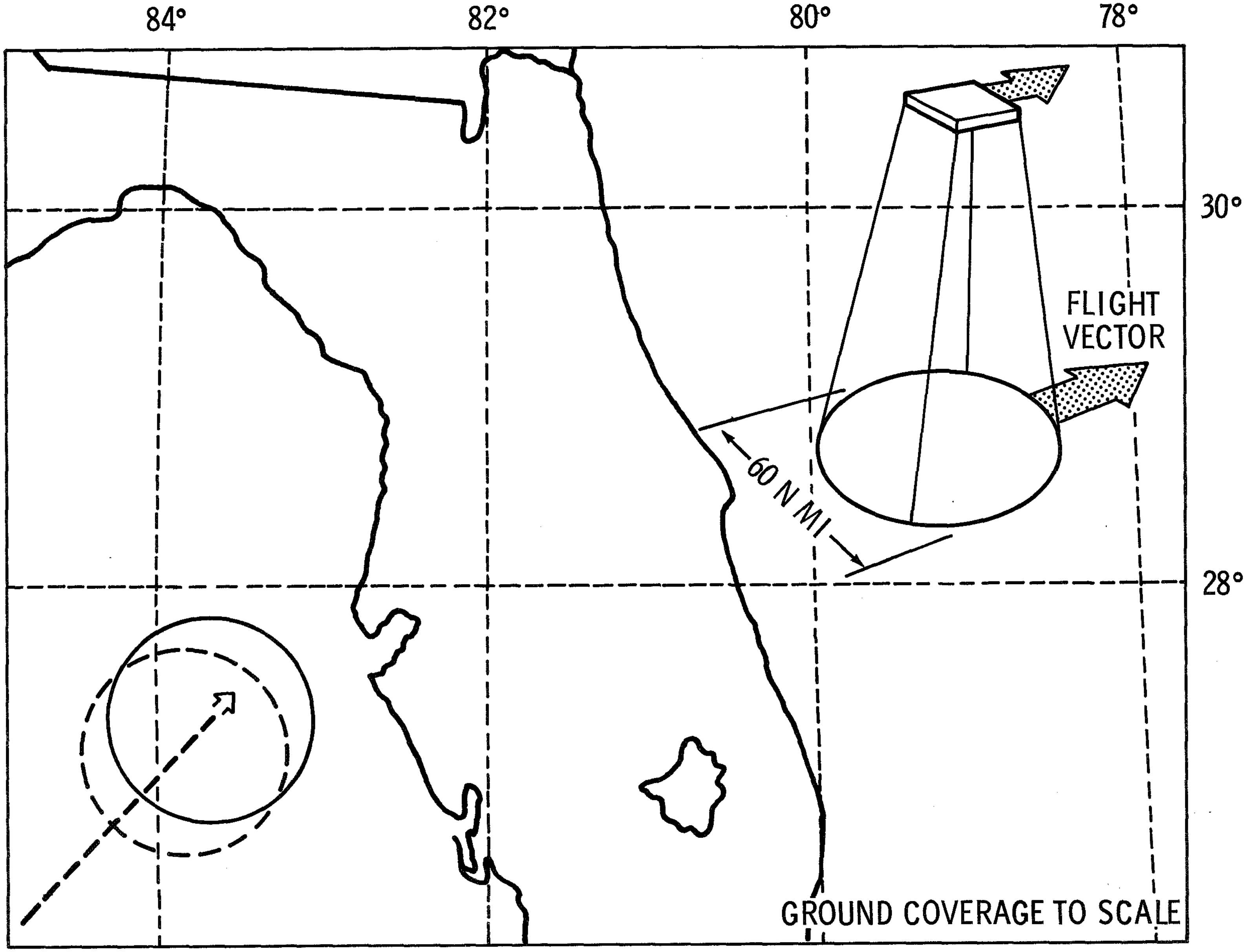
NASA-S-71-12733-V

S193 RADIOMETER/SCATTEROMETER, CROSS-TRACK NON-CONTIGUOUS MODE



NASA-S-71-13332-V

S194 L-BAND RADIOMETER, GROUND COVERAGE



NASA-S-71-13213-V

EREP TAPE/FILM MISSION USAGE

INSTRUMENT OPERATING TIME (MIN)					TAPE USAGE (FT)*	FILM USAGE (FR)	
S190	S191	S192	S193	S194		70 mm	16 mm
FIFTEEN 60 DEGREE PASSES** TYPICAL EREP MISSION							
217	30	25	145	13	10965 (38%)	1395 (116%)	3600 (64%)
TEN 60 DEGREE PASSES**							
145	20	17	97	9	7310 (25%)	930 (77%)	2400 (43%)
FIVE 120 DEGREE PASSES***							
79	11	13	68	27	5070 (17%)	540 (45%)****	1300 (23%)
				TOTAL	42%	122%	66%

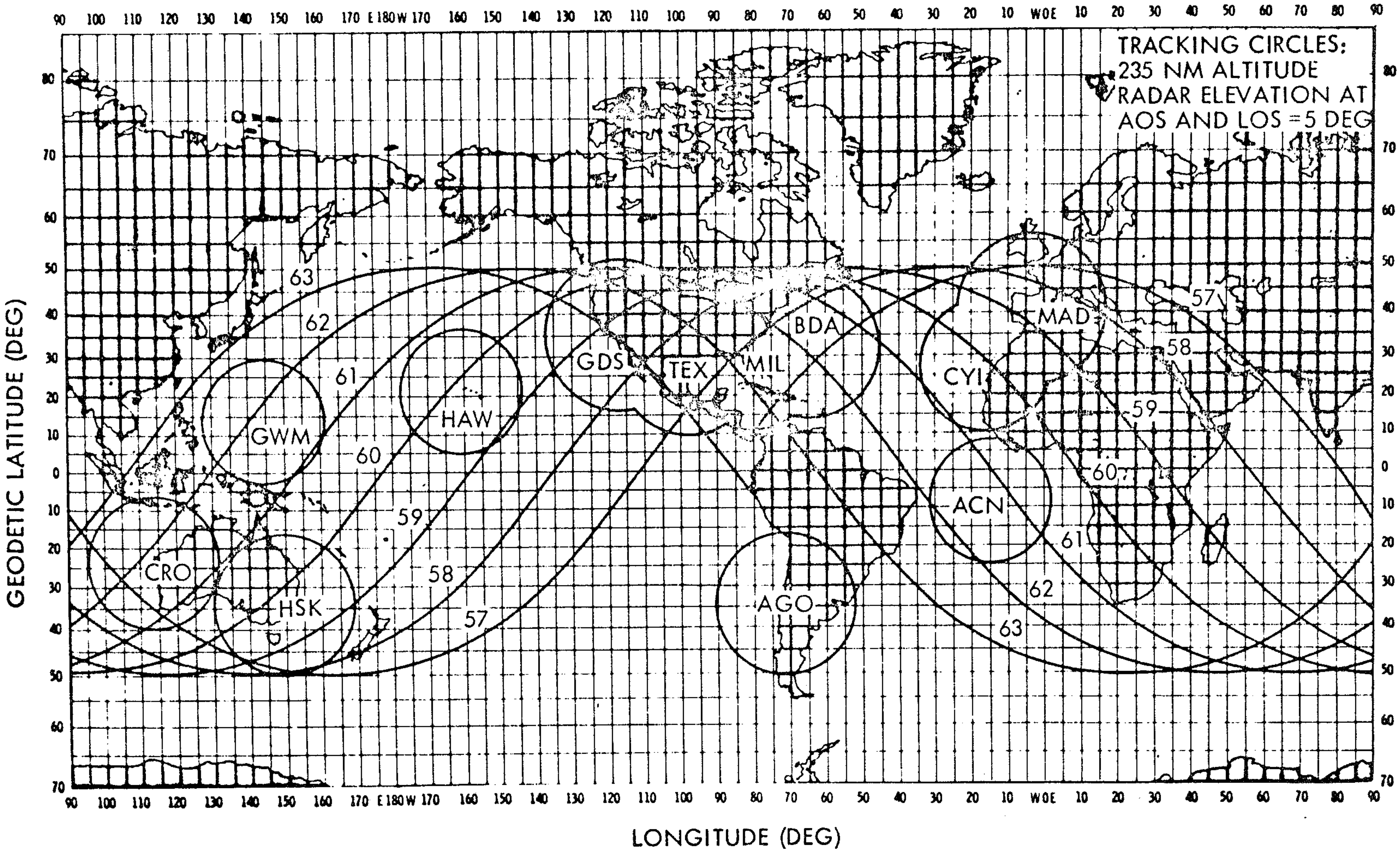
* BASED ON TAPE SPEEDS OF 3 3/4 IPS AND 60 IPS
** BASED ON REV 146/147
*** BASED ON REV 176/177
**** INCLUDES SOME OVER THE WATER COVERAGE

DATA BASED ON PRELIMINARY USAGE
OF MSC TYPICAL DTO'S

NASA-S-71-13202-V

TYPICAL SKYLAB GROUND TRACK

REVOLUTIONS 57 THRU 63

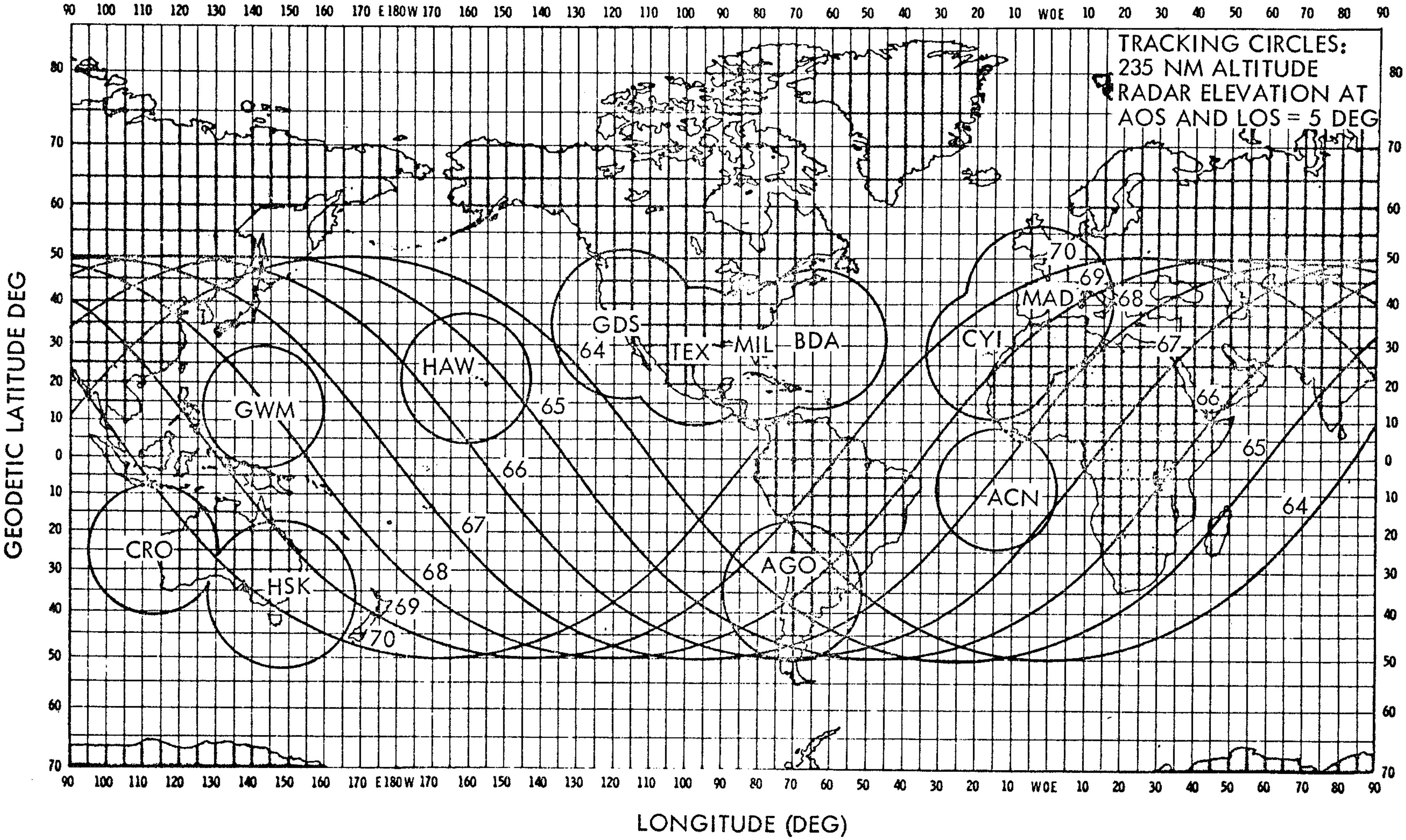


NOTE: THE GROUND TRACK SHIFTS APPROXIMATELY 1.05 DEG TO THE WEST EVERY 5 DAYS.

NASA-S-71-13201-V

TYPICAL SKYLAB GROUND TRACK

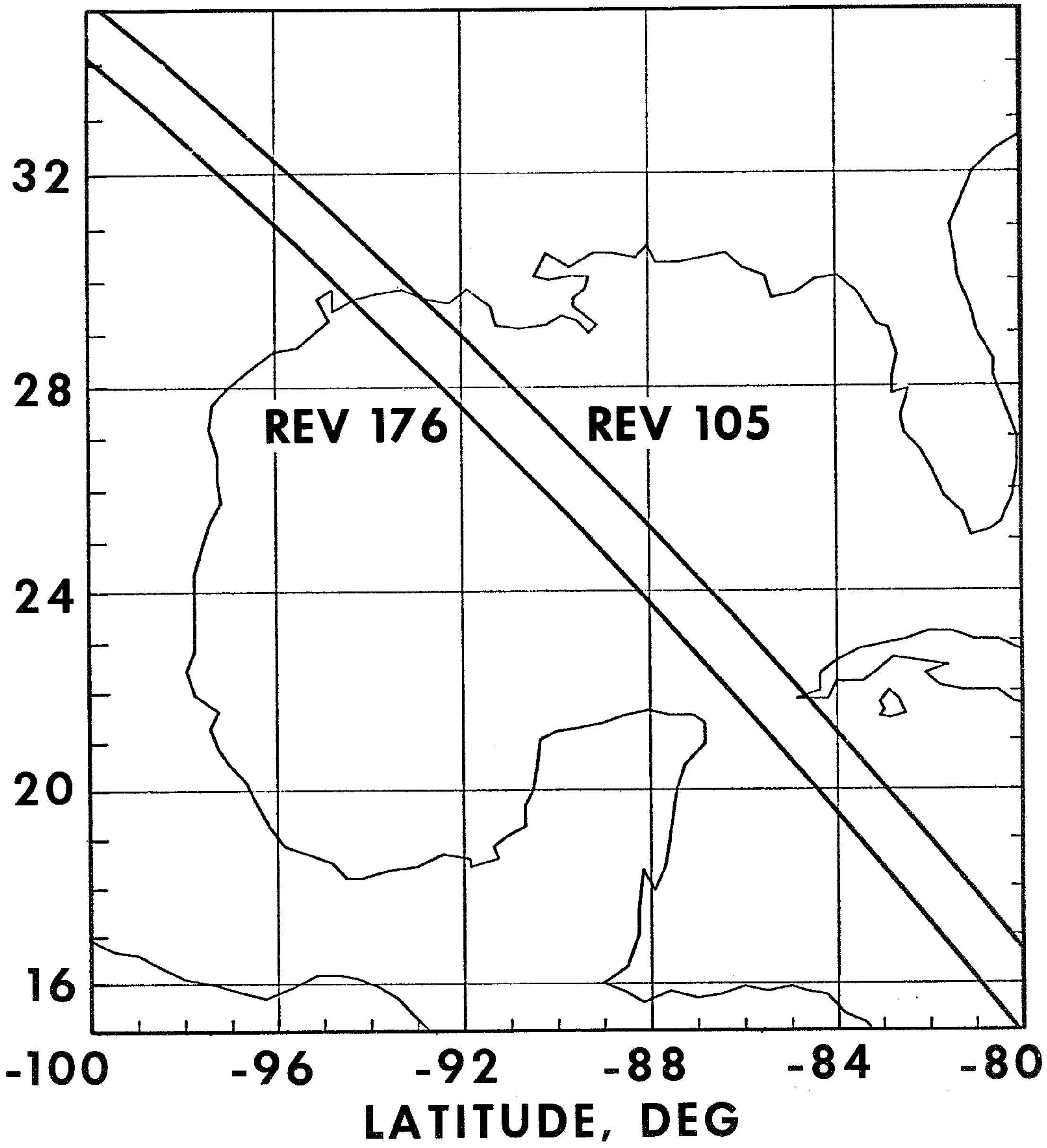
REVOLUTIONS 64 THRU 70



NOTE: THE GROUND TRACK SHIFTS APPROXIMATELY 1.05
DEG TO THE WEST EVERY 5 DAYS.

NASA-S-71-13170-X

GROUND TRACK REPEATABILITY

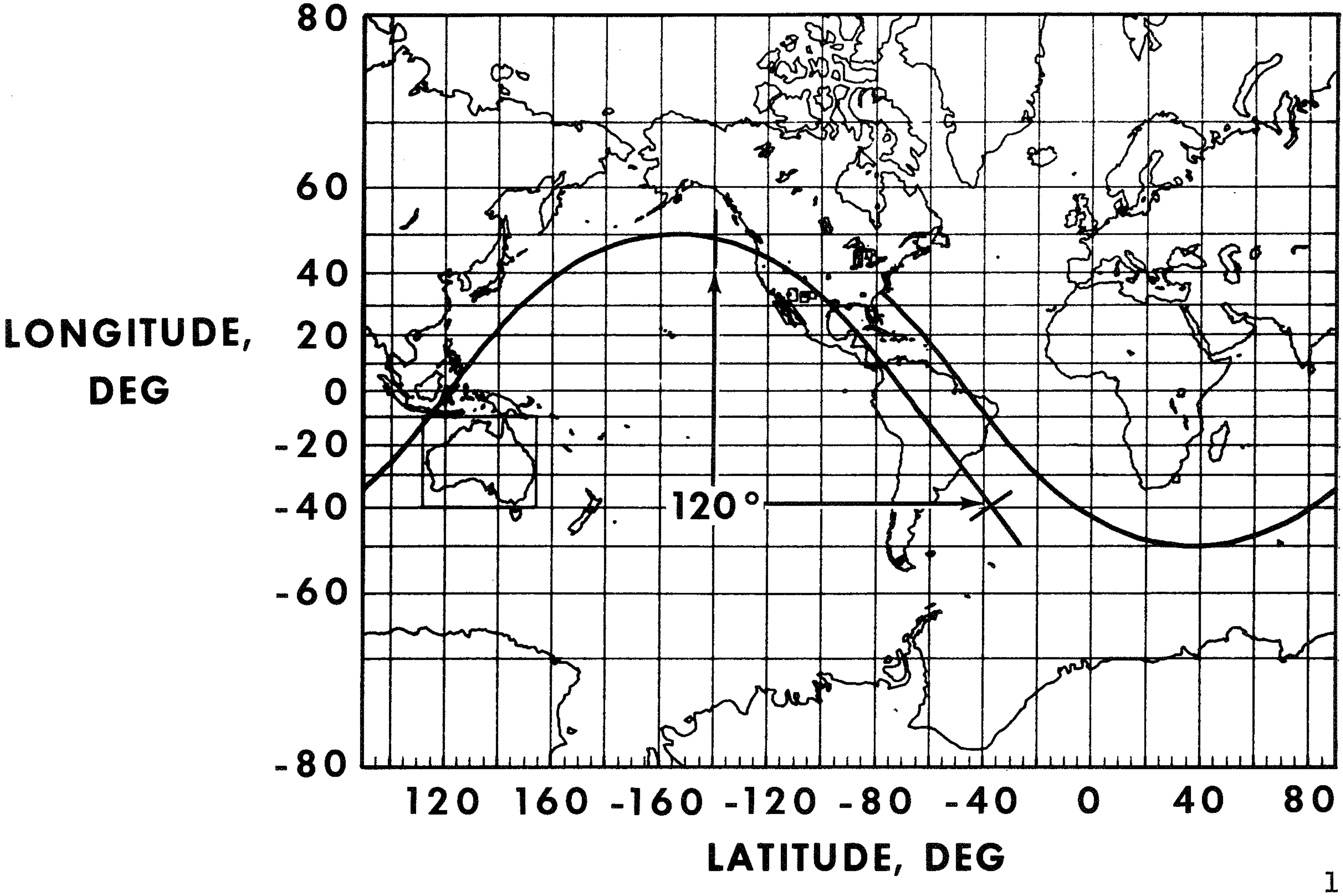


NOTE:

GROUND TRACK SEPARATION APPROX 1.05 DEG AFTER 5 DAYS OR 71 REVS

NASA-S-71-13244-S

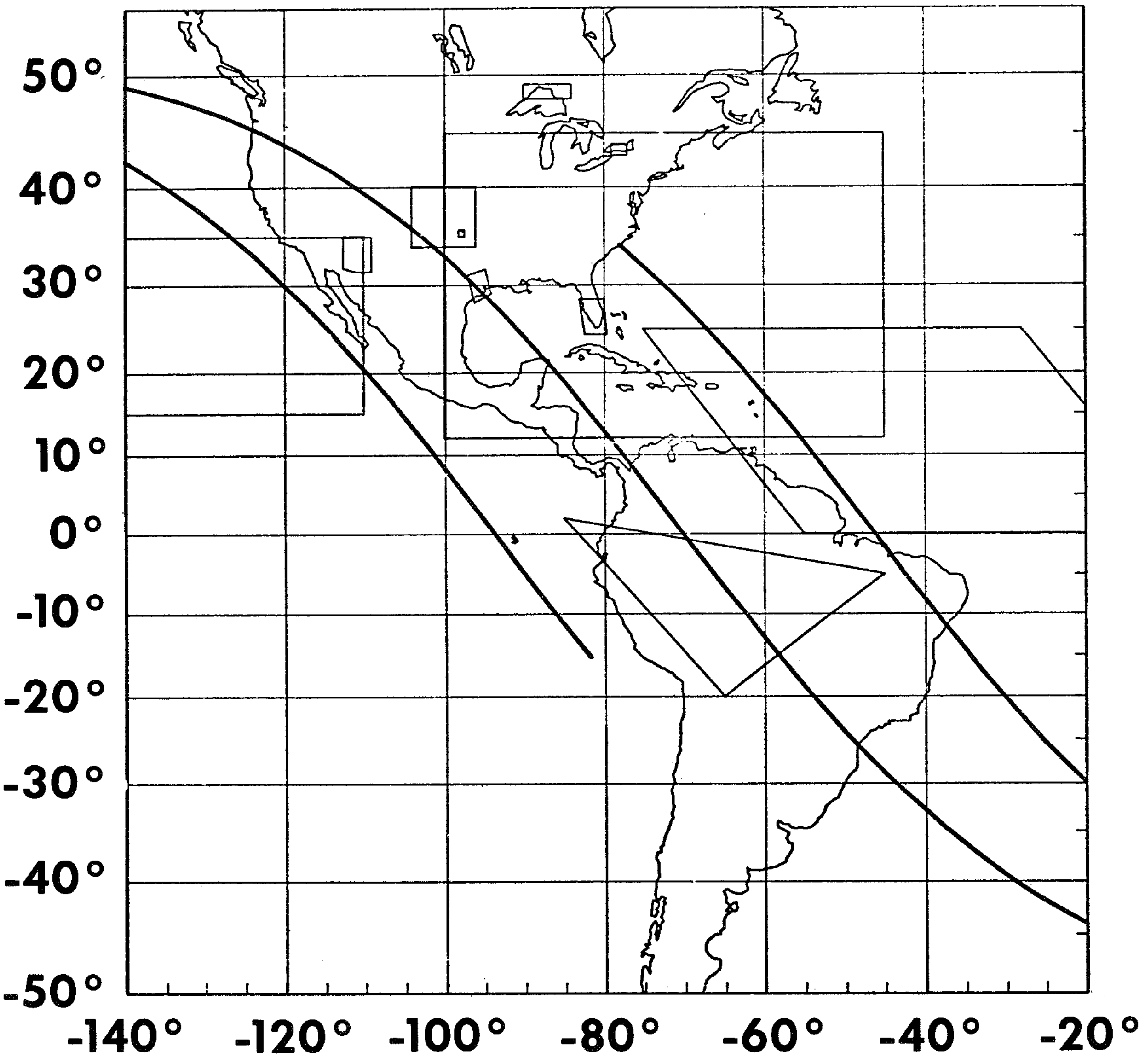
MERCATOR GROUND TRACK
120 DEGREE PASS
REV 176-177



NASA-S-71-12826-X

MERCATOR GROUND TRACK

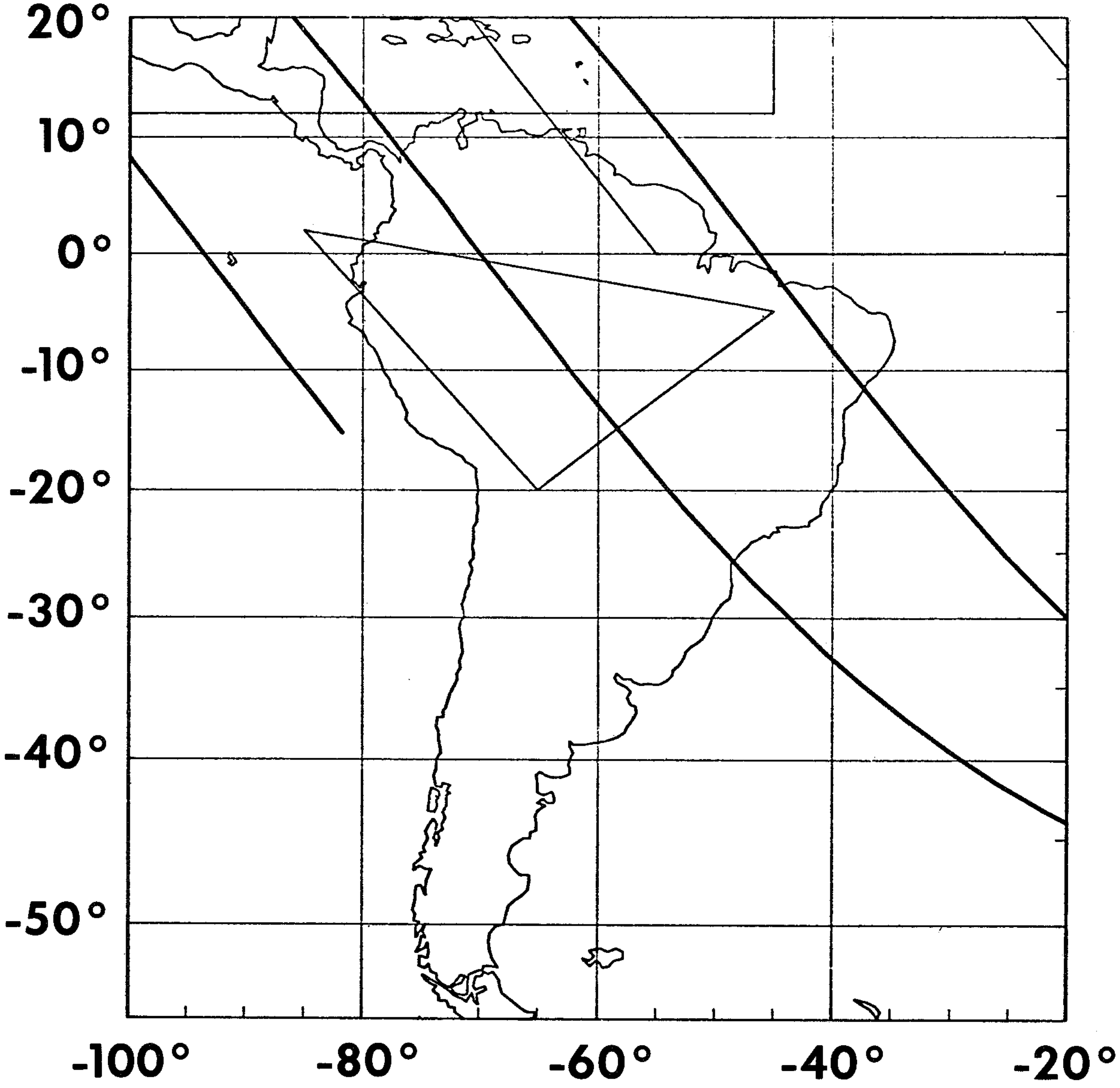
REV 176 - 178 N+S AMERICA SL-2 11/10/72



NASA-S-71-12824-X

MERCATOR GROUND TRACK

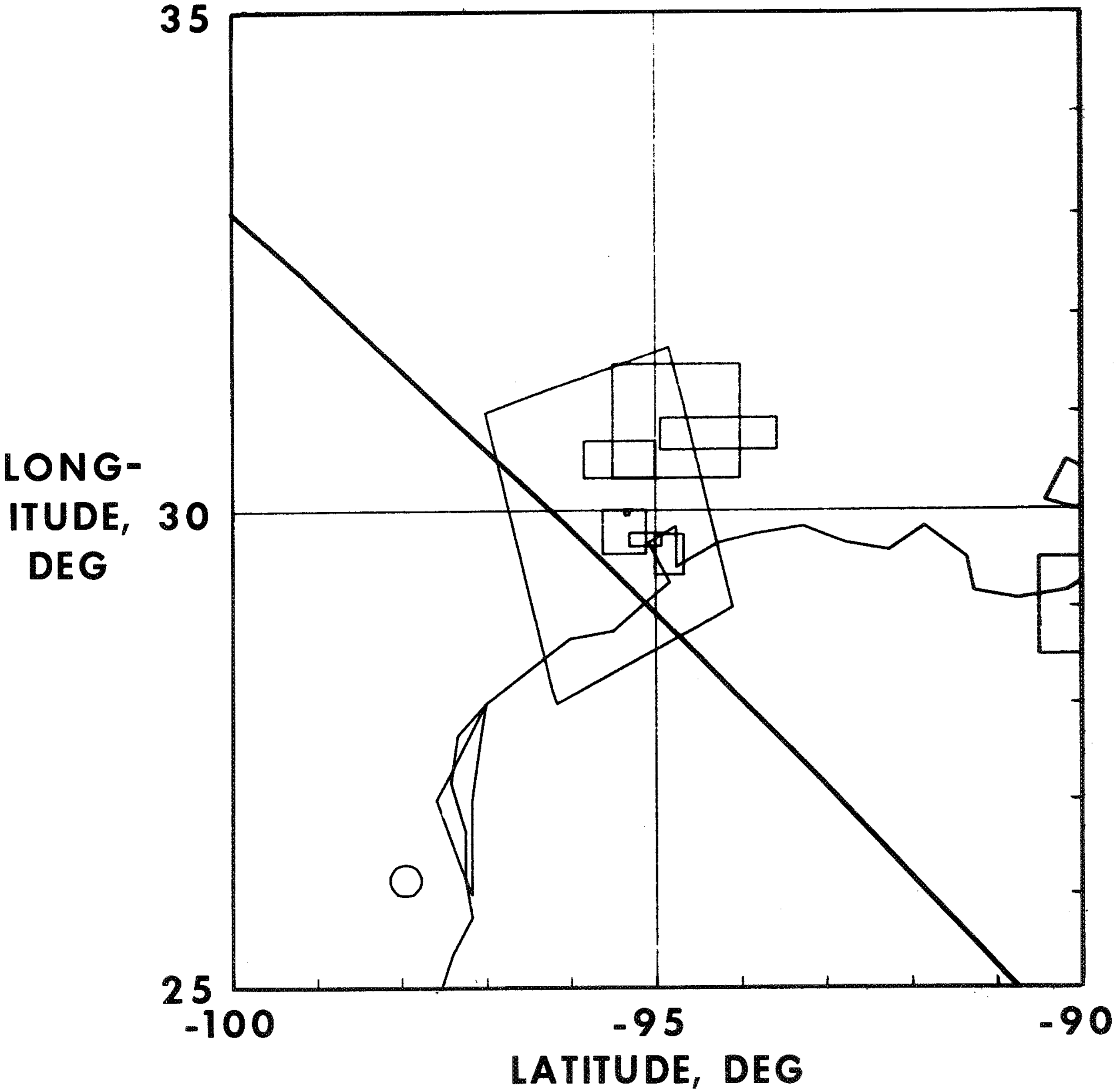
REV 176 - 178 S AMERICA SL-2 11/10/72 2



NASA-S-71-12644-S

MERCATOR GROUND TRACK

REV 176-177
HOUSTON
AREA
'L' TYPE SITES



NASA-S-71-12911-S

SKYLAB GROUND TRACK ACCURACIES

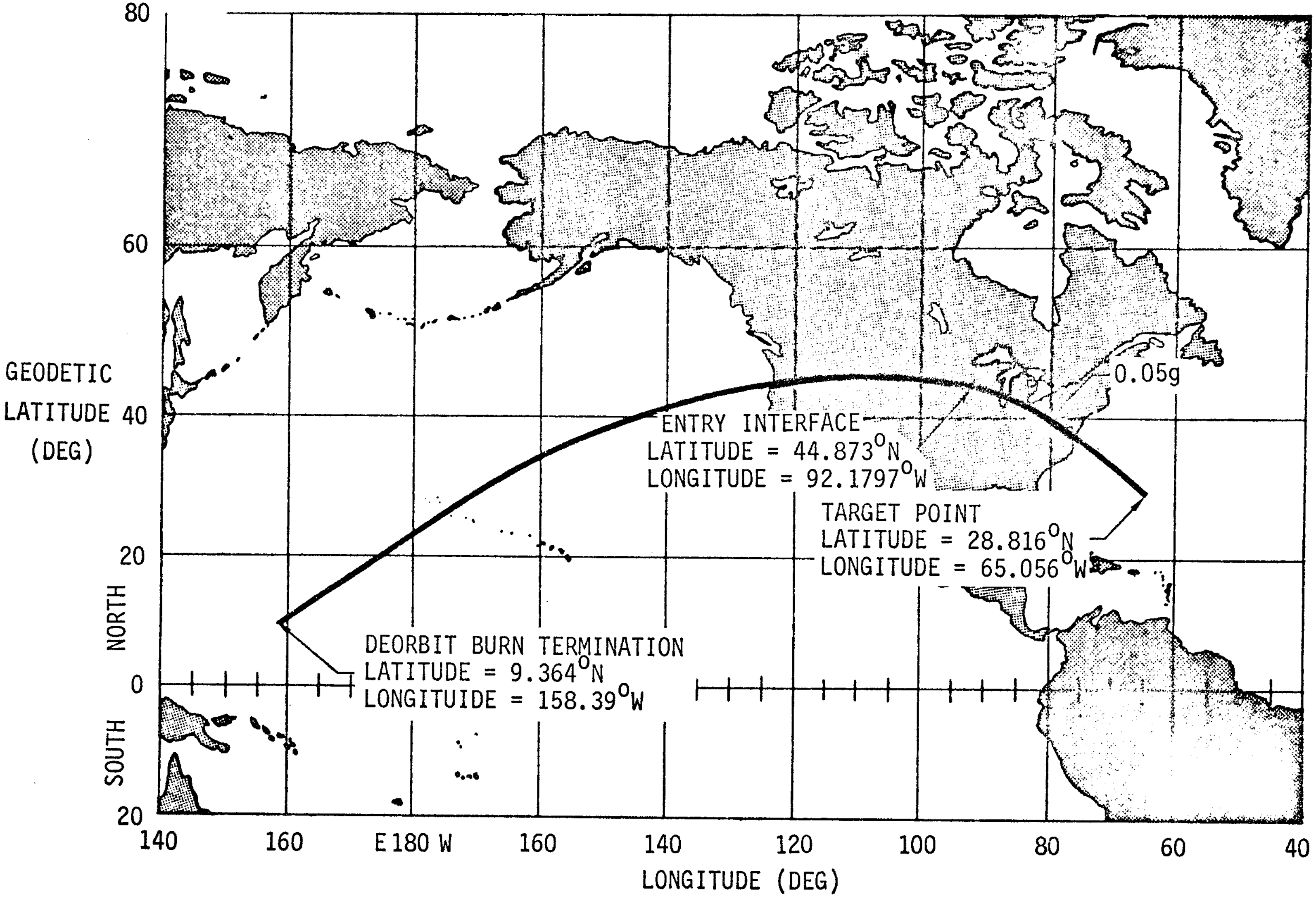
- CONDITIONS
  - TRACKING AT LEAST ONCE EVERY 6 HOURS
  - CONSERVATIVE SPACECRAFT VENTING
  - 3 SIGMA NUMBERS GIVEN
  - MANNED PHASE ONLY
- ERRORS AT TIME OF S-BAND TRACKING
  - RADIAL - 0.5 N MI
  - DOWNTRACK - 1.5 N MI
  - CROSSTRACK - 1.0 N MI
- ERROR GROWTH RATE
  - RADIAL - CYCLIC
  - DOWNTRACK - 6.0 N MI
  - CROSSTRACK - CYCLIC
  - ABOVE NEVER GREATER THAN WORST CASE
- WORST ERRORS EXPECTED DURING MANNED PHASE
  - RADIAL 0.5 N MI
  - DOWNTRACK 37.5 N MI
  - CROSSTRACK 1.0 N MI

SKYLAB ATTITUDE ACCURACY AND STABILITY

- VEHICLE NORMAL POINTING ACCURACY TO WITHIN ±2.5 DEG OF NADIR
- VEHICLE POINTING ACCURACY TO WITHIN ±0.7 DEG OF NADIR USING EXPERIMENT S193 NADIR SEEKER
- POSTFLIGHT DETERMINATION OF ACTUAL ATTITUDE WILL BE WITHIN ±0.3 DEG
- VEHICLE WILL STABILIZE OUT WITH RATES OF APPROXIMATELY 0.005 DEG/SEC

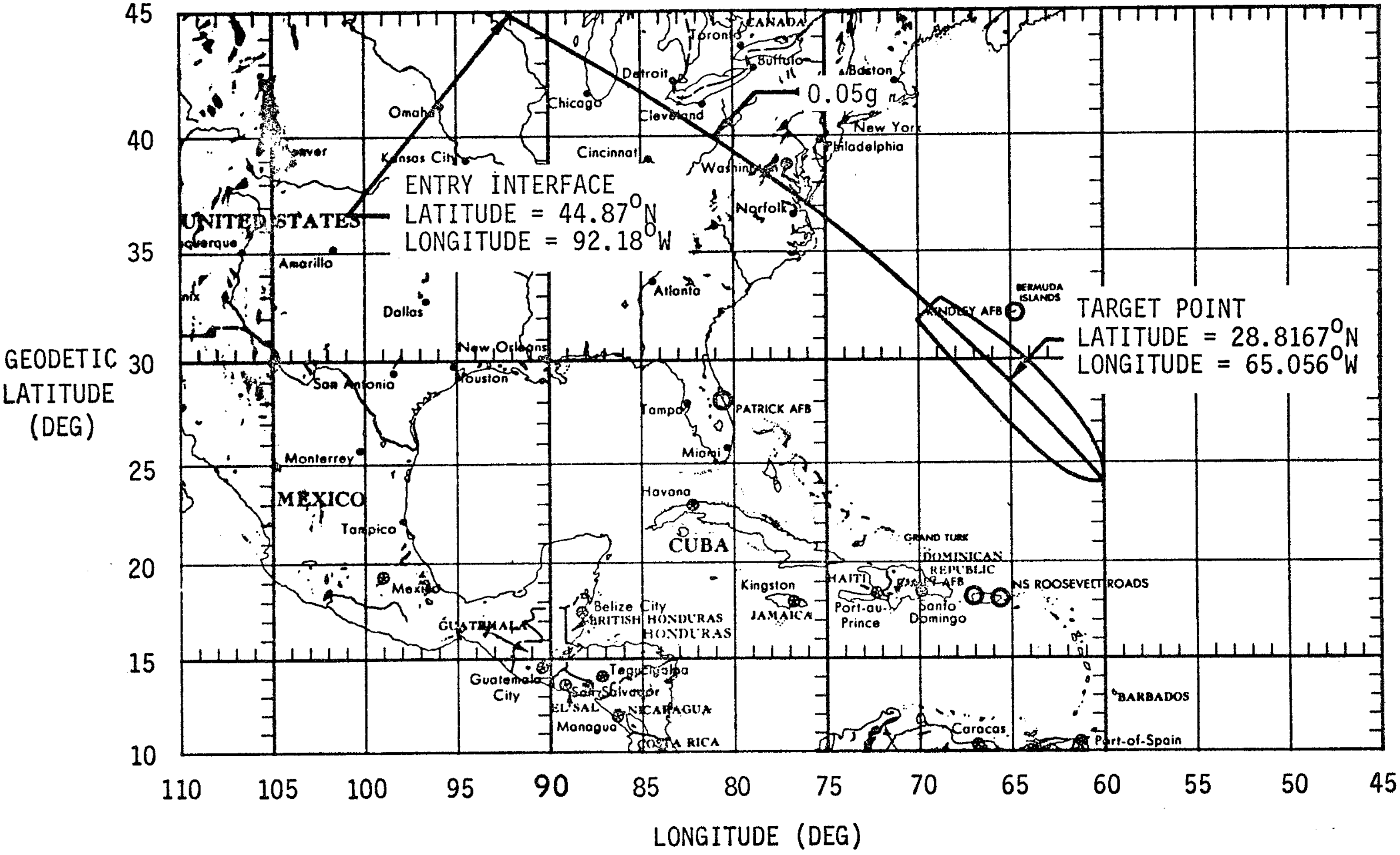
NASA-S-70-3244-V

SKYLAB ENTRY GROUND TRACK FOR ATLANTIC LANDING



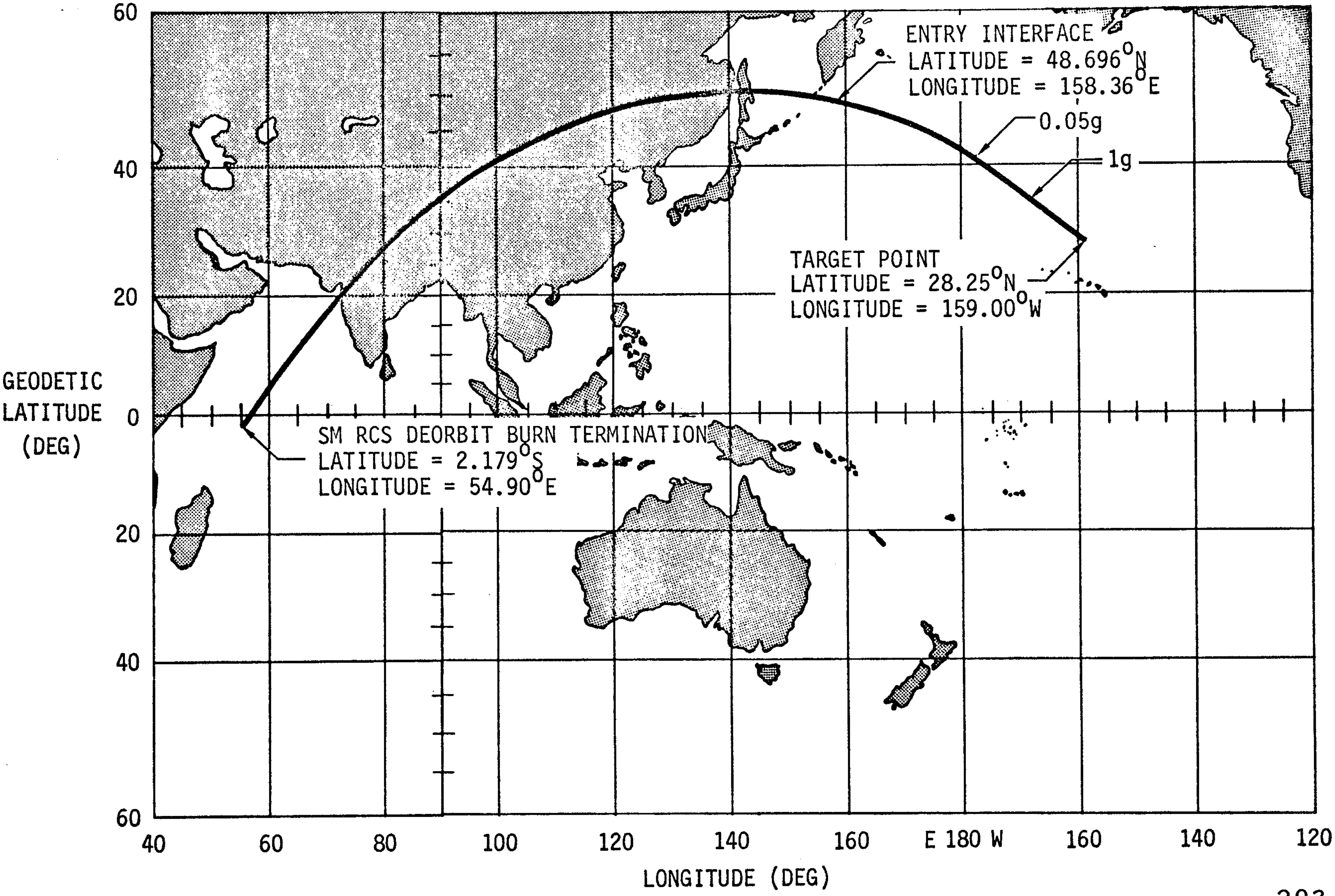
NASA-S-70-3246-V

ATLANTIC RECOVERY AREA



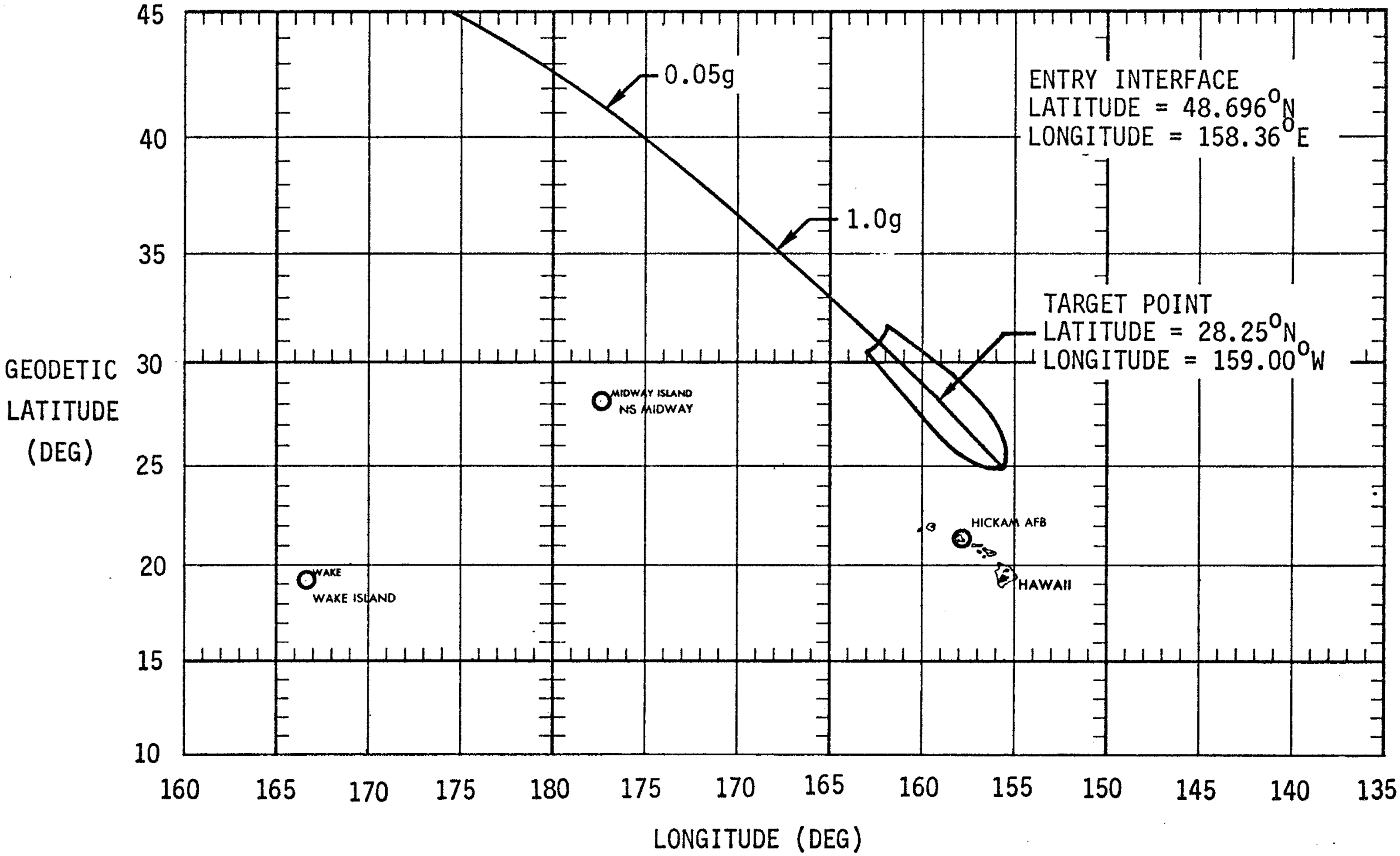
NASA-S-70-3245-V

PACIFIC LANDING



NASA-S-70-3247-V

PACIFIC RECOVERY AREA



NASA-S-71-13334-V

FLIGHT PLANNING

Page intentionally left blank

NASA-S-71-12878-V

GENERAL FLIGHT PLAN ACTIVITIES

- MAJOR MANEUVERS
  - RENDEZVOUS
  - DOCKING
  - SOLAR INERTIAL/Z LOCAL VERTICAL
  - SEPARATION
  - DEORBIT
  - ENTRY

- MAJOR ACTIVITIES
  - WORKSHOP ACTIVATION/STORAGE
  - EXPERIMENT OPERATIONS
  - EVA OPERATIONS
  - CSM/SWS SYSTEMS MONITORING
  - PERSONAL CREW ACTIVITIES

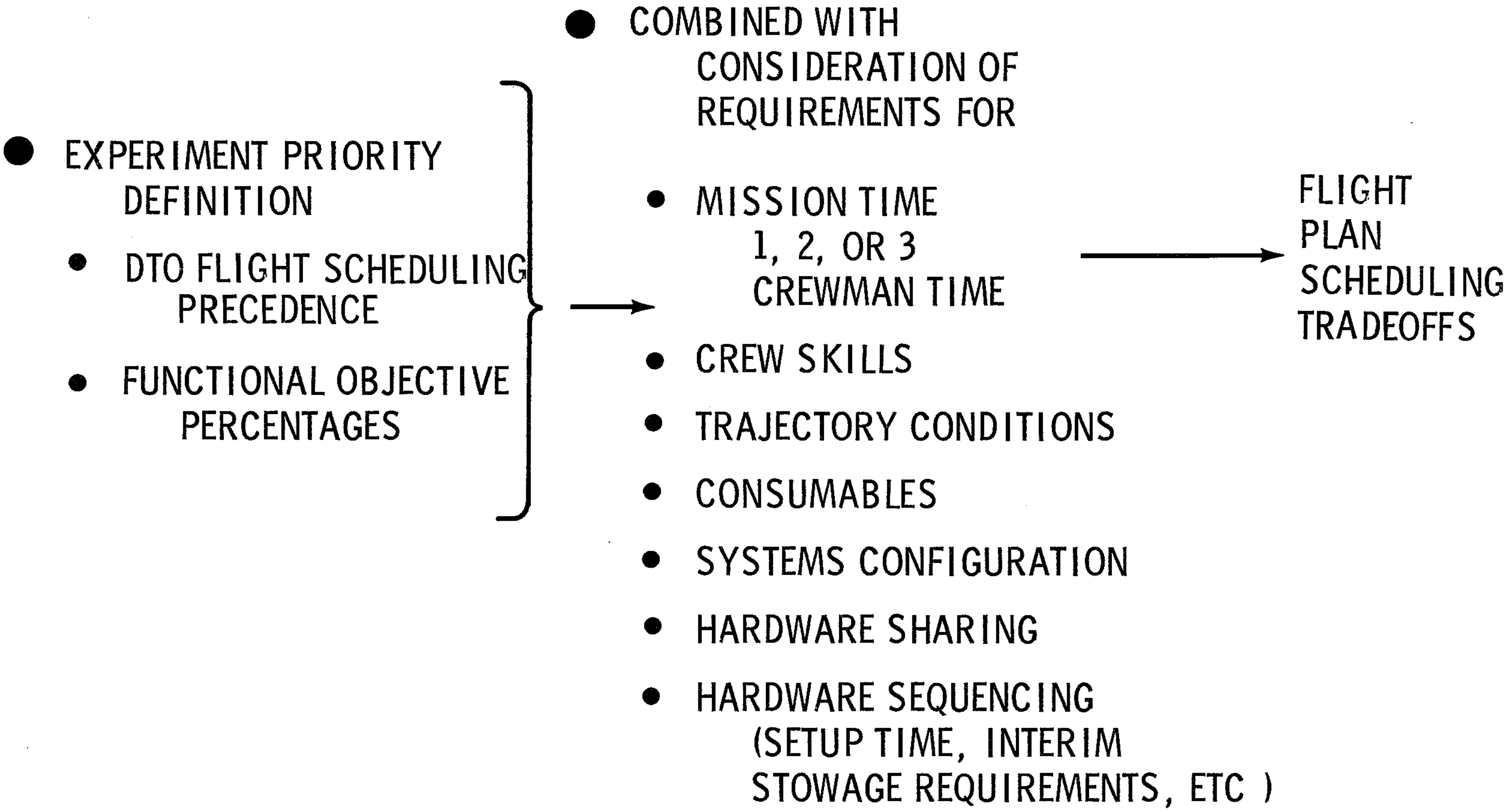
NASA -S-71-12879-V

EXTRAVEHICULAR ACTIVITY

- SL2 - EVA FOR ATM FILM REMOVAL, RETRIEVAL OF COATING SAMPLES (DO24) AND EXAMINE THE EXPANDABLE AIRLOCK (DO21)
- SL3 - 3 EVA'S FOR ATM
- SL4 - 2 EVA'S FOR ATM
- 2 CREWMAN FULLY SUITED FOR EVA
- 1 CREWMAN LOCATED FORWARD OF AIRLOCK, MONITORING SYSTEMS AS REQUIRED

NASA-S-70-5466-V

EXPERIMENT PRIORITY SYSTEM
APPLICATION IN FLIGHT PLANNING



- EXPERIMENT PRIORITY DEFINITION
  - DTO FLIGHT SCHEDULING PRECEDENCE
  - FUNCTIONAL OBJECTIVE PERCENTAGES

→

- COMBINED WITH CONSIDERATION OF REQUIREMENTS FOR
  - MISSION TIME 1, 2, OR 3 CREWMAN TIME
  - CREW SKILLS
  - TRAJECTORY CONDITIONS
  - CONSUMABLES
  - SYSTEMS CONFIGURATION
  - HARDWARE SHARING
  - HARDWARE SEQUENCING (SETUP TIME, INTERIM STOWAGE REQUIREMENTS, ETC)

→

FLIGHT
PLAN
SCHEDULING
TRADEOFFS

EXPERIMENT PRIORITY SYSTEM (CONT)

SUMMARY PRIORITY GROUNDRULES

- SCHEDULE MEDICAL EXPERIMENTS, ATM AND EREP AS PRIME
- WHERE UNIQUE REQUIREMENTS EXIST, SCHEDULE THAT EXPERIMENT WHEN THESE REQUIREMENTS ARE MET. (i.e. S063 AT OPTIMUM SOLAR DECLINATION CYCLE)
- IN THE TIME REMAINING, SCHEDULE THE EXPERIMENTS THAT FIT THE TIME BLOCKS IN ORDER OF PRIORITY
- RESOLVE SCHEDULING CONSTRAINTS AND CONFLICTS THROUGH TRADE-OFF OF PRIORITIES VERSUS MISSION RESOURCES REQUIREMENTS
- ATTEMPT TO SCHEDULE FILM USAGE TO PREVENT RETURN OF PARTIAL MAGAZINES

NASA-S-71-12516-S

EREP PLANNING RATIONALE

- PRELIMINARY MISSION PLANNING PROCEEDED USING MISSION CONSTRAINTS AND TYPICAL MISSION PROFILES AND GROUND SITES
  - FINAL GROUND SITES AND INVESTIGATIONS WILL BE AVAILABLE FOURTH QUARTER OF 1971
  - USE EARLY INTERAGENCY MEETINGS TO SCOPE MISSION PLANNING
- MISSION CAPABILITY MUST BE DEFINED PRIOR TO ISSUANCE OF 'OPPORTUNITIES' DOCUMENT
- ISSUANCE OF 'OPPORTUNITIES' DOCUMENT WAS END OF DECEMBER 1970
- MISSION CONSTRAINTS SHOULD BE RELIEVED TO MAXIMUM EXTENT POSSIBLE ALLOWING FLEXIBILITY IN PLANNING AND IMPLEMENTATION
- FLIGHT PLAN SHOULD ESTABLISH BASELINE '<u>PERIODS</u>' FOR EREP OPERATION
- CONTINGENCY '<u>PERIODS</u>' SHOULD BE PROVIDED IN FLIGHT PLAN
- '<u>IDEALIZED</u>' EREP GROUND OVERFLIGHT PLAN WILL EXIST PRIOR TO LAUNCH
- UPDATE OF OVERFLIGHT PLAN WILL BE REQUIRED AFTER STABLE ORBIT IS ATTAINED

NASA-S-71-12515-S

OPERATIONS RATIONALE

- INVESTIGATIONS AND MISSION PLANNING WILL EMPHASIZE
  - MULTIDISCIPLINARY TEST SITES
  - HIGH DENSITY INVESTIGATION AREAS
  - CORRELATION OF ERTS, SKYLAB, AIRCRAFT, AND GROUND TRUTH DATA
  - REPETITIVE AND SEASONAL SYNOPTIC COVERAGE OF SPECIFIC AREAS
  - EQUIPMENT AND TECHNIQUE DEVELOPMENT
  - TYPICAL EREP DETAILED TEST OBJECTIVES
- LIMITED NIGHT PASSES
- 30° SUN ILLUMINATION ANGLE IN SUMMER HEMISPHERE, 20° IN WINTER FOR S190
- APPROXIMATELY 75 to 80 PERCENT OF DATA WILL BE GATHERED OVER UNITED STATES WITH REMAINDER OVER PARTICIPATING NATIONS; E.G., AUSTRALIA, MEXICO, CANADA, AFRICAN NATIONS, EUROPEAN NATIONS, ET CETERA
- DETAILED GROUND TRACKS SHOWING VARIABLES MUST BE DONE AND REDONE FOR MANY MONTHS AS AN AID TO TRAINING, SCOPING OF INVESTIGATIONS, ET CETERA

NASA-S-71-12520-S

OPERATIONS RATIONALE (CONT)

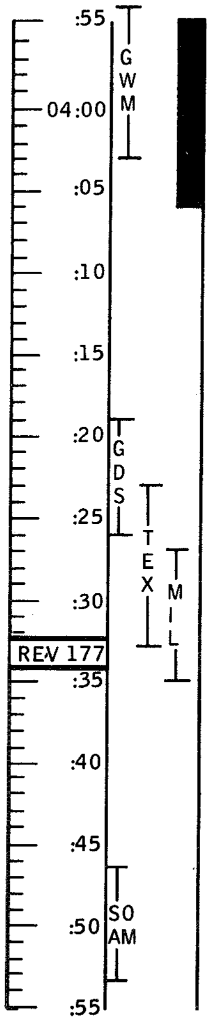
- CURRENT ESTIMATES ENVISION 100 TO 150 SEPARATE INVESTIGATIONS
- INVESTIGATIONS WILL BE INTEGRATED FROM SKYLAB, ERTS, AIRCRAFT INVESTIGATORS
- EMPHASIS MUST BE ON REAL TIME MISSION PLANNING AND SITE/INVESTIGATION SELECTION
- SPECIALIZED SOFTWARE MUST BE AVAILABLE FOR REAL TIME MISSION PLANNING AND SITE SELECTION
- REAL TIME MISSION OPERATIONS WILL INVOLVE SKYLAB, ERTS, AIRCRAFT, SURFACE SHIPS, AND GROUND TRUTH TEAMS
- AN EXTENSIVE SCIENCE SUPPORT TEAM WILL BE AVAILABLE DURING OPERATIONS
- DATA WILL REQUIRE PROCESSING AND ANALYSIS BETWEEN FLIGHTS WITH SHIFTING EMPHASIS FROM MISSION TO MISSION
- LONG RANGE AND REAL TIME METEOROLOGICAL FORECASTS WILL BE REQUIRED

NASA-S-71-13330-V

TYPICAL FLIGHT PLAN

MCC-H
MISSION DAY 13

GET HOU



CM 1

START Z-LV MANV

END Z-LV MANV

OPERATE VTS
AS REQ.

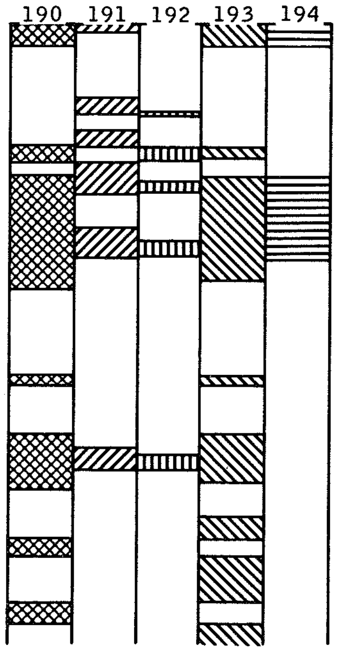
END VTS OPS

CM 2

EREP EQUIP PREP CS:3
T-20 C & D PANEL PWR - ON
T-19 S192 PWR - ON FOR WARM UP

T-13 S191 PWR - ON COOL DOWN

T-10 S192 C/O - START
T-5 S192 C/O - COMPLETE - STBY
S190 PWR ON TO START SHUTTER OP
T-4 VTS PWR ON - START TRACK
T-3 EREP SYS SW - ON - START T/R
S191 AUTO CAL - RCD
T-1.5 S194 PWR - ON - CAL - RCD



END EREP PASS NO. 9

CM 3

LUNCH CS:15

FOOD FROM FREEZER TO
REFRIGERATOR CS:15

NOTES

SAA

RCDR
ATM 1 2
AM 1 2 3

β☆
-45.7

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
SL-2	PRELIM REF	JANUARY 15, 1971	03:55 - 04:55	12/177	3-120

FLIGHT PLANNING BRANCH

NASA-S-71-13331-V

TYPICAL FLIGHT PLAN

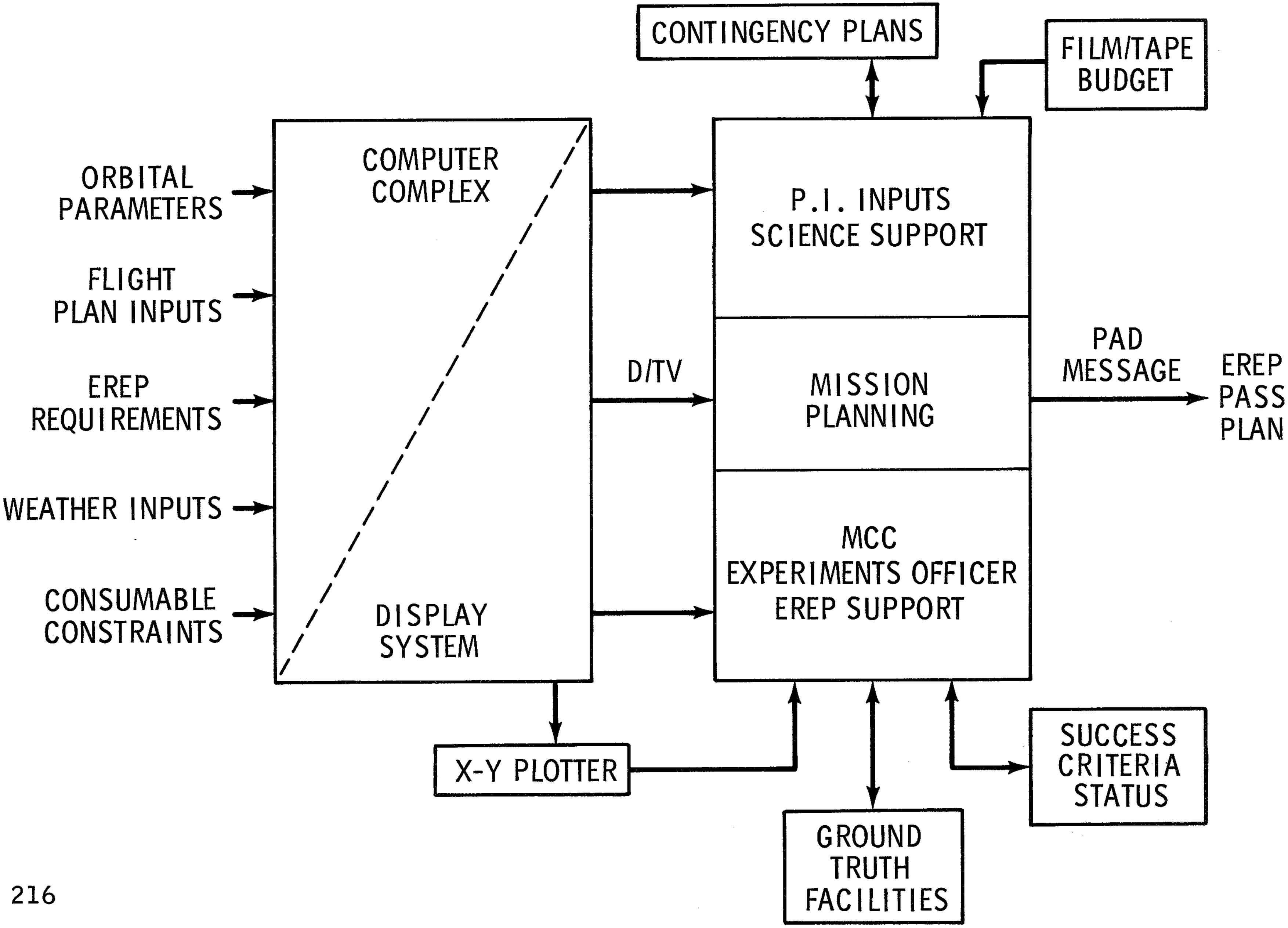
MCC-H	GET HOU	CM 1	CM 2	CM 3	NOTES SAA	NOTES RCDR ATM 1 2 AM 1 2 3
	:55	START SOLAR INERTIAL MANEUVER	S190 POST OPER S191 POST OPER S192 POST OPER S193 POST OPER S194 POST OPER	ASSIST AS REQUIRED	β* 45.9	
	05:00					
	:05					
	:10	END SI MANV				
	:15					
	:20					
	:25		END EREP POST OPER			
	:30					
	:35					
	:40					

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
SL-2	PRELIM REF	JANUARY 15, 1971	04:55 - 05:55	12/177	3-121

FLIGHT PLANNING BRANCH

NASA-S-71-12704-V

REAL TIME EREP PASS PLANNING



NASA-S-71-13316-V

REAL TIME EREP PASS PLANNING

P-5 DAYS	P-12 HOURS	P-2 HOURS	EREP PASS	POST PASS
● CANDIDATE PASS AND FINAL TARGET SELECTION ● TRUTH SITE READINESS	● TARGET AND TRUTH SITE UPDATE ● PAD MESSAGE PREPARATION	● PAD MESSAGE UPDATE ● EREP SYSTEMS CHECKOUT AND SETUP	● COMMIT TO Z-LOCAL VERTICAL ● CREW COMMENTS & DOWNLINK	● TRUTH SITE DEBRIEFING ● EREP PASS EVALUATION

NASA-S-71-13302-V

REAL TIME EREP PASS PLANNING

PREPASS

[PASS - 5 DAYS TO PASS - 12 HRS]

- CANDIDATE PASS AND FINAL TARGET SELECTION
  - TARGET TABLE
  - GROUND TRACK DISPLAY AND GRAPHICS
  - CONSTRAINTS SUN ANGLE, BETA ANGLE, ETC
  - EXPERIMENT FIELDS OF VIEW DISPLAYS
  - WEATHER
  - TARGET PRIORITY
  - ERTS AND OTHERS
  - ORBITAL ASSM SYSTEM AND CONSUMABLES STATUS
  - SCHEDULING
  - EREP SYSTEM STATUS

- TRUTH SITE READINESS
  - INSTRUMENTATION STATUS AND SCHEDULING
  - COMMUNICATION CHECK
  - AIRCRAFT AND SHIP STATUS
  - WEATHER
  - PERSONNEL STATUS

NASA-S-71-13303-V

REAL TIME EREP PASS PLANNING

PREPASS

[PASS -12 HRS TO PASS -2 HRS]

- TARGET AND TRUTH SITE UPDATE
  - WEATHER
  - MISSION TIMELINE/ RESCHEDULE
  - BEST ESTIMATE OF TRAJECTORY
  - AIRCRAFT AND SHIP STATUS
  - EREP SYSTEMS STATUS
  - TRUTH SITE ADVISORY MESSAGE

- PAD MESSAGE PREPARATION
  - WEATHER
  - EREP EXPERIMENTS REQUIRED
  - TRUTH SITE NAME AND LOCATION
  - FILM AND FILTER COMBINATIONS
  - C&D PANEL SWITCHES (SCHEDULE)
  - MAPS/GRAPHICS
  - MISSION TIMELINE
  - BEST ESTIMATE OF TRAJECTORY
  - GMT UPDATE
  - GROUND TRACK
  - SITE AOS/LOS TIME
  - SUN ANGLE AND BETA ANGLE
  - POINTING
  - CHECKLIST REVISIONS
  - Z-LOCAL VERTICAL MANEUVER TIME
  - SKYLAB SYSTEMS CONFIGURATION
  - TRUTH SITE INFORMATION (PREPASS)

NASA-S-71-13319-V

REAL TIME EREP PASS PLANNING

PREPASS

[PASS - 2 HRS TO EREP PASS]

- PAD MESSAGE UPDATE
  - SAME AS PAD MESSAGE PREPARATION
- EREP SYSTEMS CHECKOUT AND SETUP
  - ELECTRICAL POWER SYSTEM AVAILABLE
  - THERMAL SYSTEM CHECKOUT
  - VERIFY SWITCHES, FILM, AND FILTERS
  - MAGNETIC TAPE NUMBER
  - EXPERIMENT CHECKOUT PARAMETERS
  - ANOMALIES; CHECKLIST REVISIONS
  - HOUSEKEEPING CALIBRATION CURVES
  - CHECKOUT TIMELINE; MISSION RULES

NASA-S-71-13313-V

REAL TIME EREP PASS PLANNING

EREP PASS

- COMMIT TO Z-LOCAL VERTICAL
- CREW COMMENTS AND DOWNLINK
  - ELECTRICAL POWER SYSTEM, THERMAL, COOLANT
  - S190 WINDOW
  - SPACECRAFT ATTITUDE AND RATES
  - SPACECRAFT EPHEMERIS AND ALTITUDE
  - TRUTH SITE COORDINATION
  - CREW EVALUATION/OBSERVATIONS
  - AIRLOCK MODULE RECORDER DUMP
  - CONSUMABLE USAGE

NASA-S-71-13301-V

REAL TIME EREP PASS PLANNING

POST PASS

- TRUTH SITE DEBRIEFING
  - WEATHER
  - EXPERIMENTS OPERATION
  - PRINCIPAL INVESTIGATOR COMMENTS

- EREP PASS EVALUATION
  - CREW COMMENTS
  - PRINCIPAL INVESTIGATOR COMMENTS
  - EPHEMERIS
  - ATTITUDE AND ATTITUDE RATES
  - CONSUMABLE USAGE
  - GROUND TRACK AND GRAPHICS
  - COMPARE PLANNED OPERATIONS WITH ACTUAL

- EXTENDED OPERATIONS
  - UPDATED FLIGHT PATTERNS
  - EXTENDED DATA GATHERING REQUIREMENTS

- DATA RETRIEVAL
  - TARGET LOCATIONS
  - TRUTH SITE, SHIPS, AIRCRAFT LOCATIONS
  - SCIENTIFIC DATA
  - EXPERIMENT OPERATIONS STATUS
  - RETRIEVAL CHECKLIST

- TARGET PRIORITY UPDATE
  - DTO COMPLETION
  - PRINCIPAL INVESTIGATOR COMMENTS

NASA-S-71-12698-V

EREP DATA HANDLING

Page intentionally left blank

NASA-S-71-13205-V

EREP DATA

- REAL TIME DATA
  - MISSION PLANNING - SUPPORT DATA
  - NO EREP DATA IS TELEMETERED
  - CREW LOGS AND TAPE
  - MCC UPDATES - PREADVISORY
- BETWEEN MISSION DATA
  - DATA RECOVERY AND DISPOSITION
  - QUICK LOOK DATA
  - SCIENCE SCREENING
  - PI DATA REQUIREMENTS
  - EREP TAPE RECORDER
- DATA PROCESSING
  - DATA VOLUME
  - DATA PROCESSING TIME
  - PCM PROCESSING
- DATA FACILITIES/SERVICES

NASA-S-71-12924-S

EREP DATA HANDLING

EREP DATA ACQUISITION

- FILM RECORDED DATA (PER MISSION)
  - 18-70 mm CASSETTES FILM FROM S190
  - 1-16 mm CASSETTE FILM FROM S191
- MAGNETIC TAPE RECORDED DATA
  - S190 SUPPORT DATA - NRZ-L FORMAT
  - S191 MILLER ENCODED DIGITAL DATA
  - S192 MILLER ENCODED DIGITAL DATA
  - S193 NRZ-L FORMAT
  - S194 NRZ-L FORMAT
  - AIRLOCK TIME - GMT

EREP DATA HANDLING (CONT)

EREP DATA ACQUISITION

- LOGS
  - MISSION LOGS WILL BE PREPARED IN FLIGHT. ENTRIES RELATING TO EREP SENSORS AND SYSTEMS WILL BE TRANSCRIBED FOR USE BY INVESTIGATORS AFTER RETURN OF DATA TO EARTH
- EREP ON-BOARD TAPE RECORDER
  - AMPEX AR700
    - ONE INCH TAPE, 7200 FOOT REELS
    - 28 DATA TRACKS
    - WILL RUN AT 3.75 IPS WHEN S192 IS OFF
    - WILL RUN AT 60 IPS WHILE S192 OPERATES

NASA-S-71-13172-S

VOLUME OF DATA FROM THE SKYLAB A EARTH RESOURCES EXPERIMENT PACKAGE

- THE SKYLAB A WILL BE MANNED THREE TIMES DURING ITS SCHEDULED YEAR OF OPERATION. EACH MANNED PERIOD WILL BE CALLED A MISSION. THE FOLLOWING IS A TABULATION OF THE DATA TO BE RETURNED AT THE END OF EACH MISSION (THREE MISSIONS PER YEAR).
  - ORIGINAL DATA

– 70 MM B & W FILM	4800 FRAMES
– 70 MM COLOR	2400 FRAMES
– 16 MM B & W FILM	5600 FRAMES
– 1 INCH, 28 TRACK MAGNETIC TAPE MILLER ENCODED PCM, 20 000 BITS/INCH/TRACK	4-7200 FT REELS

NASA-S-71-12525-S

VOLUME OF DATA FROM THE SKYLAB A EARTH RESOURCES EXPERIMENT PACKAGE (CONT)

- DUPLICATE DATA

— 70 MM B & W FILM (POSITIVES) 10 CYS	48 000 FRAMES
— 70 MM COLOR FILM (POSITIVES) 10 CYS	24 000 FRAMES
— 70 MM B & W FILM (NEGATIVES) 10 CYS	48 000 FRAMES
— 70 MM PAPER PRINTS 10 CYS	72 000 FRAMES
— 70 MM FALSE COLOR COMPOSITES (TRANSPARENCIES) 1200 × 10 CYS	12 000 FRAMES
— 70 MM FALSE COLOR COMPOSITE PAPER PRINTS 1200 × 10 CYS	12 000 FRAMES
— COMPUTER-GENERATED MAPS PRODUCED BY PATTERN RECOGNITION 10% OF DATA, 10 CYS	1200 FRAMES
— 9.5 INCH B & W FILM (POSITIVES) 10 CYS, 10 CHANNELS	1440 FT
— 9.5 INCH B & W FILM (NEGATIVES)	1440 FT
— 9.5 INCH COLOR COMPOSITES 10 CYS, 5 COMBINATIONS	7200 FT
— 1 INCH, ANALOG MAGNETIC TAPE, 10 000 BITS/INCH/TRACK 4 CYS S192 ANALOG TAPES 10 CYS S193 (EACH PART OF SENSOR SYSTEM) 10 CYS S194 10 CYS S191	204-7200 FT REELS

NASA-S-71-12765-V

SUPPORT DATA FOR EREP EXPERIMENTS

REQUIRED DATA

IDENTIFICATION	DESCRIPTION	DESIRED ACCURACY	SOURCE
SPACECRAFT TIME	G.m.t. IS NEEDED FOR TIME CORRELATION PURPOSES IN TERMS OF THE MONTH, DAY HOUR, MINUTE, AND SECOND	±0.1 sec	SPACECRAFT TELEMETRY
SPACECRAFT ATTITUDE	TO ACCURATELY DETERMINE THE SENSOR POINTING DURING PERIODS OF EXPERIMENT OPERATION, THE PITCH AND ROLL POSITION OF THE ORBITAL ASSEMBLY IN DEGREES FROM NADIR AND THE YAW IN DEGREES OF THE X-AXIS DEVIATION FROM THE ORBITAL PLANE IS DESIRED	±0.1°	SPACECRAFT TELEMETRY OF STRAP-DOWN PARAMETERS
SPACECRAFT DRIFT RATES	TO ACCURATELY DETERMINE WHETHER SPACECRAFT RATES INTERFERE WITH DATA QUALITY, THE PITCH, ROLL, AND YAW RATES IN DEGREES PER SECOND ARE NEEDED	±0.005°/sec	SPACECRAFT TELEMETRY OF RATE GYRO SIGNALS
MDA AMBIENT TEMPERATURE	TO HELP ASSURE THE QUALITY OF THE S190 EREP DATA, THE TEMPERATURE OF THE AMBIENT AIR MEASURED AT TBD POSITION (LOCATION RELATIVE TO THE INTERNAL SIDE OF THE MDA S190 WINDOW) IS NEEDED	±0.2°	TELEMETRY

NASA-S-71-12783-V

SUPPORT DATA FOR EREP EXPERIMENTS (CONT)

REQUIRED DATA

IDENTIFICATION	DESCRIPTION	DESIRED ACCURACY	SOURCE
EXPERIMENT POWER VOLTAGE	TO ASSURE PROPER VOLTAGE IS DELIVERED TO THE EQUIPMENT, THE MDA POWER BUS VOLTAGE IS NEEDED	±0.2 V	TELEMETRY
AMBIENT HUMIDITY OF THE MDA	TO VERIFY THE USEFULNESS OF THE FILM AND THEREFORE THE DATA OBTAINED IN THE EREP EXPERIMENTS, THE AMOUNT OF WATER VAPOR IN THE AMBIENT AIR MEASURED AT TBD POSITION IN THE MDA IS NEEDED	±2% OF MAXIMUM MEASUREMENT ALLOWED	TELEMETRY
WINDOW INTERNAL SURFACE TEMPERATURE	TO HELP ASSURE THE QUALITY OF THE S190 WINDOW/GLASS THE TEMPERATURE OF A POINT LOCATED AT TBD POSITION ON THE INTERNAL SURFACE OF THE MDA S190 WINDOW IS NEEDED	±0.2°	TELEMETRY
SPACECRAFT ORBITAL POSITION	TO ACCURATELY DETERMINE THE GEOGRAPHICAL AREA OF THE EARTH COVERED BY THE EXPERIMENT SENSORS AND TO USE THE EPHEMERAL DATA, THE SPACECRAFT SUBPOINT IS NEEDED IN DEGREES OF LATITUDE AND LONGITUDE	±0.1 N MI	RADAR TRACKING

NASA-S-71-12768-V

SUPPORT DATA FOR EREP EXPERIMENTS (CONT)

REQUIRED DATA

IDENTIFICATION	DESCRIPTION	DESIRED ACCURACY	SOURCE
SPACECRAFT ALTITUDE	TO ACCURATELY DETERMINE THE TARGET DISTANCE FOR DATA EVALUATION, THE ALTITUDE OF THE SPACECRAFT IS DESIRED, IN N MI. THESE DATA ARE ALSO REQUIRED TO DETERMINE ACCURATE ORBIT PARAMETERS	±0.1 N MI	RADAR TRACKING
TIME, G.m.t.	SIMILAR TO TELEMETERED DATA BUT SHOULD CONTAIN U.T.2 REFERENCE AND DIFFERENCE FROM OA COMPUTER TIME	±.001 sec	U.T.2
ORBIT ECCENTRICITY	THE AMOUNT OF NONCIRCULAR SHAPE OF THE ORBIT	$\pm 1X10^{-7}$	*C
ORBIT INCLINATION	ANGLE OF TRACK WITH EQUATOR AT CROSSING (ASCENSION)	+.002°	C
ORBIT ASCENDING NODE LONGITUDE	POSITION OF ASCENSION ALONG EQUATOR	±.002°	C

*C = COMPUTED FROM POSITION, ALTITUDE, AND TIME TO THE "DESIRED ACCURACY"

NASA-S-71-12769-V

SUPPORT DATA FOR EREP EXPERIMENTS (CONT)

REQUIRED DATA

IDENTIFICATION	DESCRIPTION	DESIRED ACCURACY	SOURCE
SPACECRAFT ORBIT POSITION (ω ANGLE-ORBIT ANGLE FROM EQUATOR)	POSITION OF SPACECRAFT AFTER CROSSING EQUATOR	±.002°	*C
SPACECRAFT VELOCITY	SPACECRAFT GROUND SPEED IS REQUIRED TO AID IN DATA EVALUATION	±10 KNOTS	C
SUN ELEVATION ANGLE	TO DETERMINE THE LIGHTING CHARACTERISTICS DURING EXPERIMENT OPERATION, THE ANGLE IN DEGREES OF THE SUN ELEVATION ABOVE THE HORIZON AS MEASURED FROM THE SUBPOINT IS NEEDED	±0.5°	EPHEMERAL DATA USING TIME AND ORBITAL POSITION
BETA ANGLE	TO SUPPORT CALCULATION FOR EREP EXPERIMENTS, THE BETA ANGLE IS NEEDED. THIS ANGLE IS MEASURED BETWEEN THE ORBITAL PLANE AND THE SUN NADIR. IT IS MEASURED IN THE PLANE THAT CONTAINS THE SUN NADIR AND IS PERPENDICULAR TO THE ORBITAL PLANE. IT IS THUS THE SMALLEST ANGLE BETWEEN THE SUN NADIR AND THE ORBITAL PLANE	±0.1°	CALCULATED FROM ORBITAL POSITION DATA

*C = COMPUTED FROM POSITION, ALTITUDE, AND TIME TO THE "DESIRED ACCURACY"

SUPPORT DATA FOR EREP EXPERIMENTS - ASTRONAUT DIRECT

REQUIRED DATA

IDENTIFICATION	DESCRIPTION	DESIRED ACCURACY	SOURCE
OPERATIONAL LOG BOOKS	TO ACQUIRE RELEVANT ASTRONAUT DATA THE PERTINENT INFORMATION FROM THE OPERATIONAL LOG BOOKS SHALL BE USED	N/A	LOG BOOK TRANSCRIPTS
VOICE LOG DATA	TO ACQUIRE RELEVANT ASTRONAUT COMMENTS THE TRANSCRIPTS OF THE ASTRONAUTS VOICE COMMENTS RELATIVE TO EREP DATA ARE NEEDED, e.g., RADIATION LEVELS, WASTE DUMPS, CONDENSATION ON WINDOWS, ETC	N/A	CLUSTER TAPE RECORDERS

NASA-S-71-12915-S

EREP SUPPORT DATA

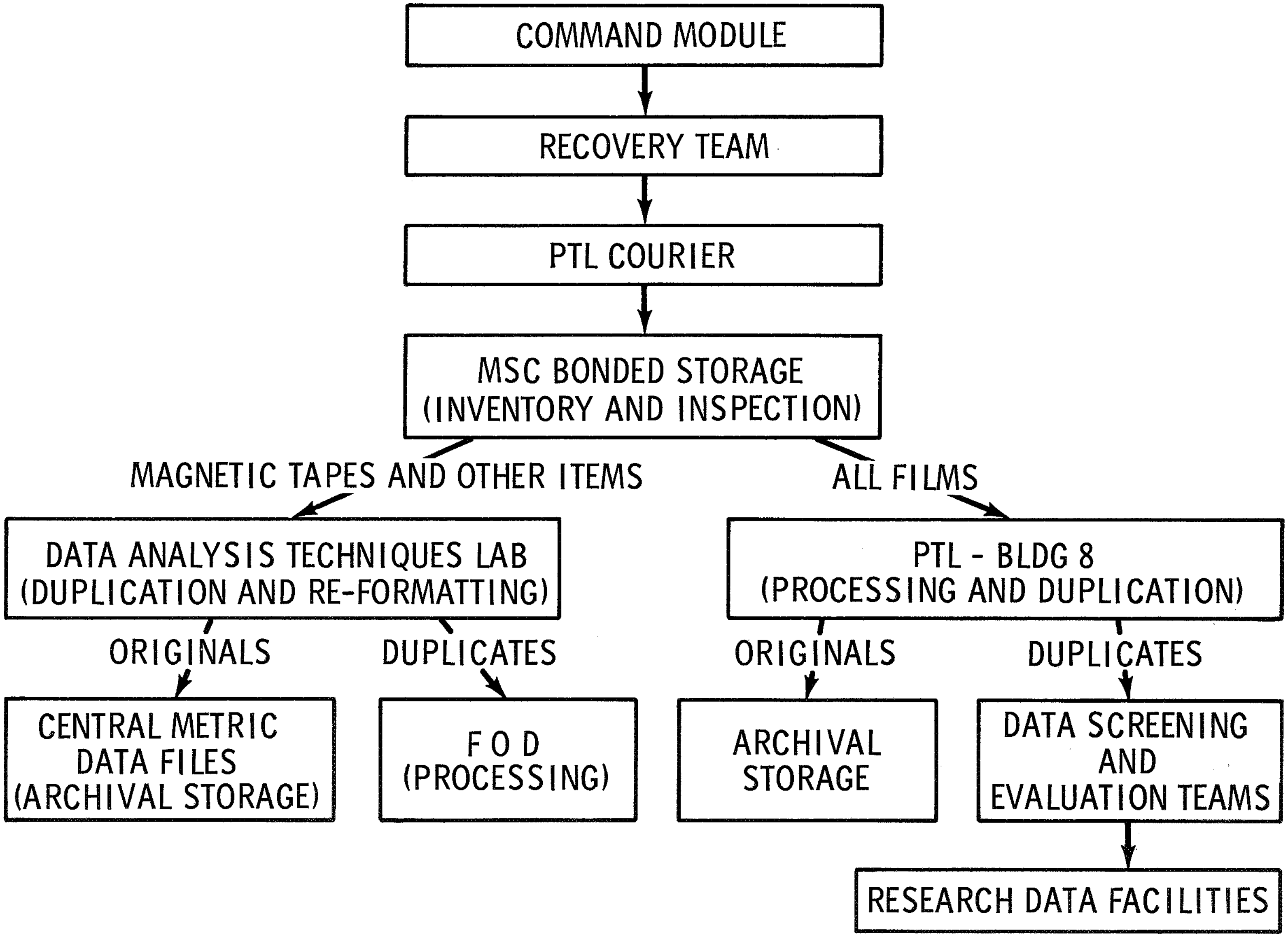
- THE FOLLOWING SUPPORT DATA WILL BE PROVIDED FOR SCREENING OPERATIONS AND WILL BE TRANSMITTED TO APPROVED INVESTIGATORS AS APPROPRIATE
  - FLIGHT LOGS
  - BEST ESTIMATE TRAJECTORY
  - VOICE TRANSCRIPTS VS TIME
  - MISSION ANOMALIES VS TIME
  - MAPS OF FLIGHT TRACK VS TIME

- ANNOTATIONS
  - ALL S190 FILM WILL BE ANNOTATED TO SHOW
    - COORDINATES OF PRINCIPAL POINT AND CORNER POINTS IN LATITUDE, LONGITUDE
    - TIME, GMT, G.E.T. (DAYS, HRS, MIN, SEC)
    - ALTITUDE, N MI
    - WAVELENGTH BAND FOR EACH PHOTO
    - FILM TYPE
    - EXPOSURE TIME
    - DENSITY AND GAMMA USED FOR PROCESSING
    - FILTER
    - GENERATION OF COPY

NASA-S-71-13214-V

RECOVERY, RETURN, AND DISPOSITION ROUTE EREP DATA

CONSISTING OF: 18 CASSETTES OF 70 mm FILM, ONE REEL OF 16 mm FILM, 4
REELS OF MAGNATIC TAPE, AND OTHER ITEMS SUCH AS LOGS, ETC.



COMMAND MODULE

RECOVERY TEAM

PTL COURIER

MSC BONDED STORAGE
(INVENTORY AND INSPECTION)

MAGNETIC TAPES AND OTHER ITEMS

ALL FILMS

DATA ANALYSIS TECHNIQUES LAB
(DUPLICATION AND RE-FORMATTING)

PTL - BLDG 8
(PROCESSING AND DUPLICATION)

ORIGINALS

DUPLICATES

ORIGINALS

DUPLICATES

CENTRAL METRIC
DATA FILES
(ARCHIVAL STORAGE)

FOD
(PROCESSING)

ARCHIVAL
STORAGE

DATA SCREENING
AND
EVALUATION TEAMS

RESEARCH DATA FACILITIES

NASA-S-71-13215-V

RECOVERED DATA

ASSOCIATED EXPERIMENT	DATA MEDIA	QUANTITY
S190	EK 3443 (IR COLOR) EK S0242 (COLOR) EK 2424 IR AEROGRAPHIC (B&W) EK 3400 PANATOMIC-X AERIAL (B&W) NOTE - THESE ARE NOMINAL FILM TYPES. OTHER TYPES MIGHT BE EMPLOYED.	3 CASSETTES 3 CASSETTES 6 CASSETTES 6 CASSETTES
S191	EK 3401 (B&W) (16 mm x 140 FT)	1 REEL
S190 S191 S192 S193 S194	MAGNETIC TAPES (1 IN. x 0.001 IN. x 7200 FT)	4 REELS

NASA-S-71-12919-S

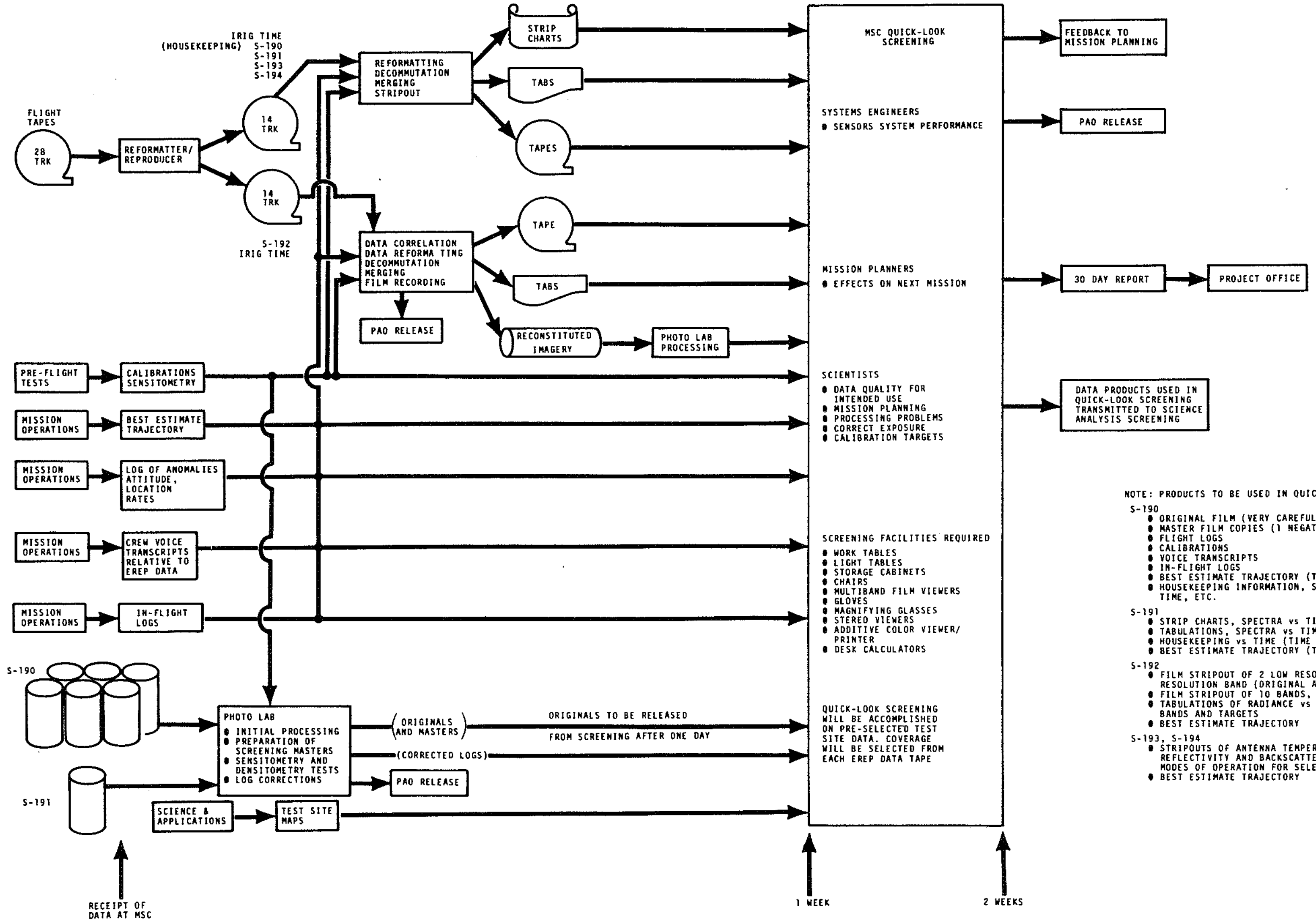
QUICK LOOK PROCESSING

- QUICK LOOK DATA PRODUCTS WILL BE PREPARED FOR PRESELECTED TEST SITES WITHIN ONE WEEK AFTER RECEIPT OF DATA AT MSC. THE PURPOSE OF THE QUICK LOOK SCREENING IS TO DETERMINE CORRECTIONS FOR THE NEXT MISSION
  - ALL FLIGHT FILM WILL BE PROCESSED SELECTED TEST SITES DATA, WILL BE DUPLICATED
  - MAGNETIC TAPE RECORDED DATA WILL BE PROCESSED TO PRODUCE STRIP CHARTS, TABULATIONS, SCOPE PICTURES AS FOLLOWS
    - SELECTED IMAGERY BANDS FROM S192
    - SELECTED SPECTRA FOR S191
    - SELECTED REFLECTIVITY, RADIANCE, ALTIMETER OUT-PUTS FROM S193
    - SELECTED RADIANCE FROM S194
  - LOGS — ALL LOGS AND VOICE RECORDINGS WILL BE DUPLICATED OR TRANSCRIBED AS REQUIRED FOR EREP SENSOR EVALUATIONS

NASA-S-71-12502-V

SKYLAB EREP DATA FLOW - PHASE I

PROCESSING FOR QUICK LOOK SCREENING



NOTE: PRODUCTS TO BE USED IN QUICK-LOOK SCREENING:

S-190
- ORIGINAL FILM (VERY CAREFUL HANDLING)
- MASTER FILM COPIES (1 NEGATIVE AND 1 POSITIVE)
- FLIGHT LOGS
- CALIBRATIONS
- VOICE TRANSCRIPTS
- IN-FLIGHT LOGS
- BEST ESTIMATE TRAJECTORY (TIME vs LOCATION)
- HOUSEKEEPING INFORMATION, SHUTTER PULSES vs TIME, ETC.

S-191
- STRIP CHARTS, SPECTRA vs TIME
- TABULATIONS, SPECTRA vs TIME
- HOUSEKEEPING vs TIME (TIME vs LOOK ANGLE, ETC.)
- BEST ESTIMATE TRAJECTORY (TIME vs LOCATION)

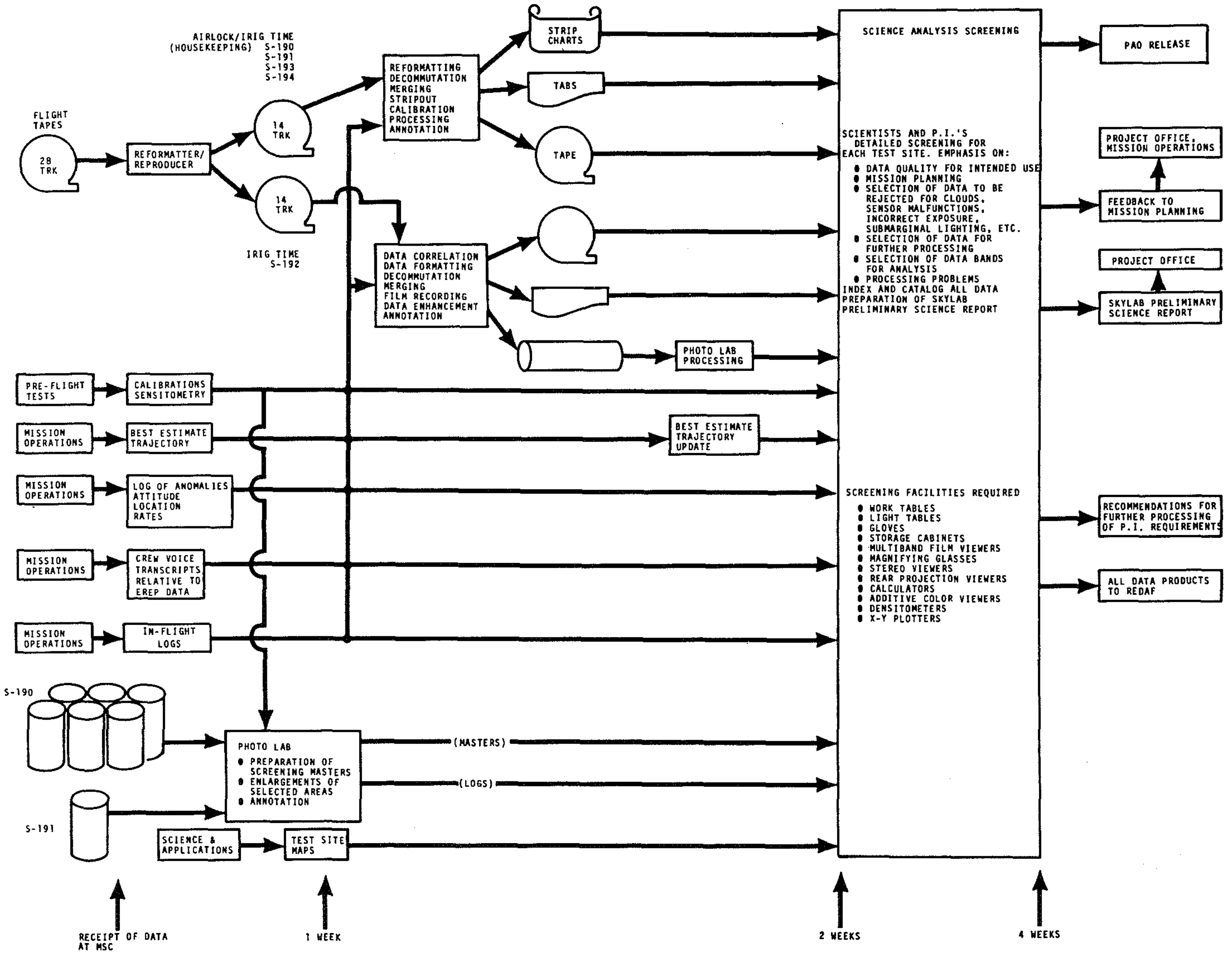
S-192
- FILM STRIPOUT OF 2 LOW RESOLUTION AND 1 HIGH RESOLUTION BAND (ORIGINAL AND POSITIVE MASTER)
- FILM STRIPOUT OF 10 BANDS, SMALL SELECTED AREAS
- TABULATIONS OF RADIANCE vs TIME FOR SELECTED BANDS AND TARGETS
- BEST ESTIMATE TRAJECTORY

S-193, S-194
- STRIPOUTS OF ANTENNA TEMPERATURE, RADIANCE, REFLECTIVITY AND BACKSCATTER vs TIME IN ALL MODES OF OPERATION FOR SELECTED TEST SITES
- BEST ESTIMATE TRAJECTORY

NASA-S-71-12503-V

SKYLAB EREP DATA FLOW - PHASE II

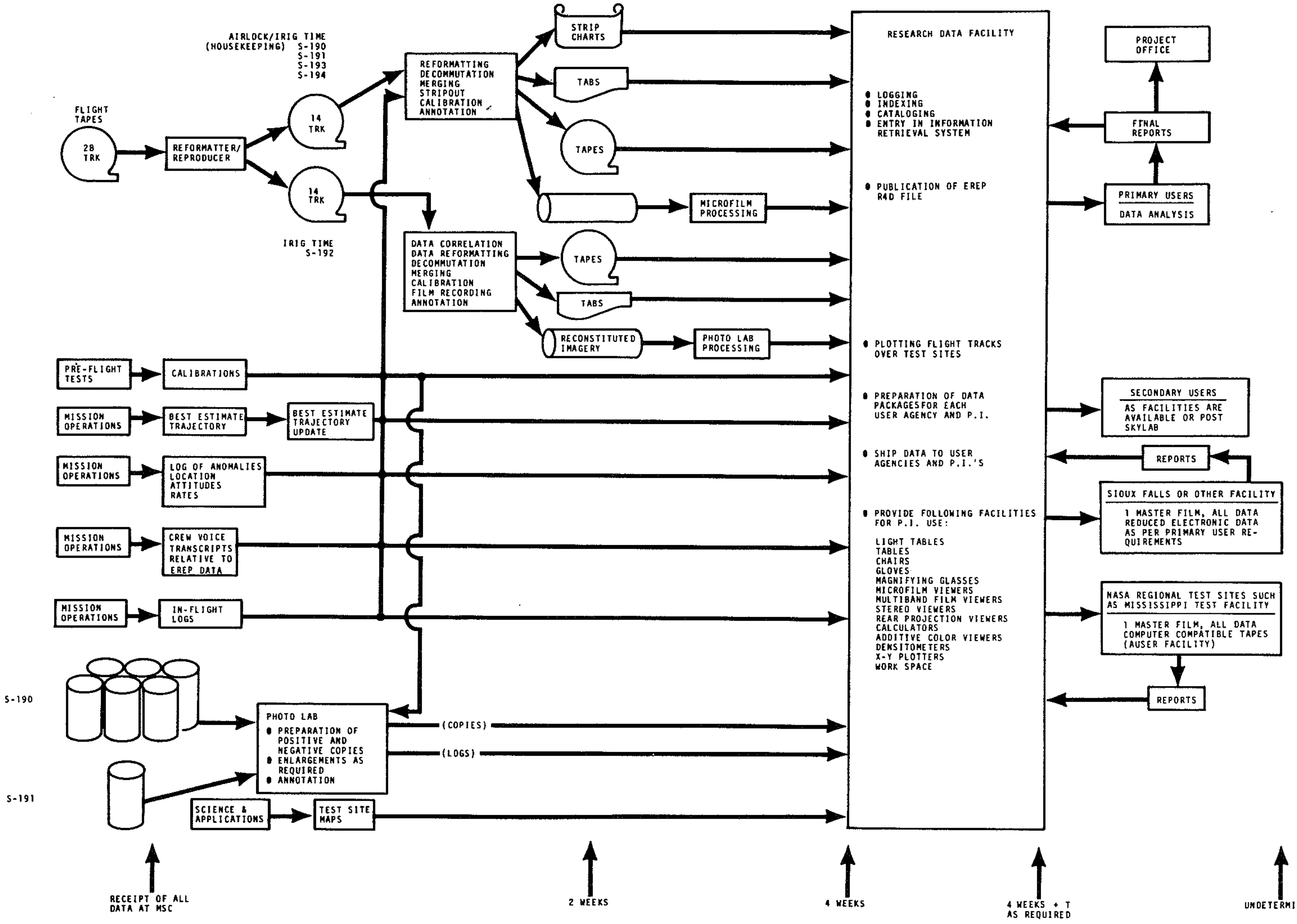
PROCESSING FOR SCIENCE ANALYSIS SCREENING



NASA-S-71-12504-V

SKYLAB EREP DATA FLOW - PHASE III

FINAL DATA PROCESSING FOR P.I. REQUIREMENTS



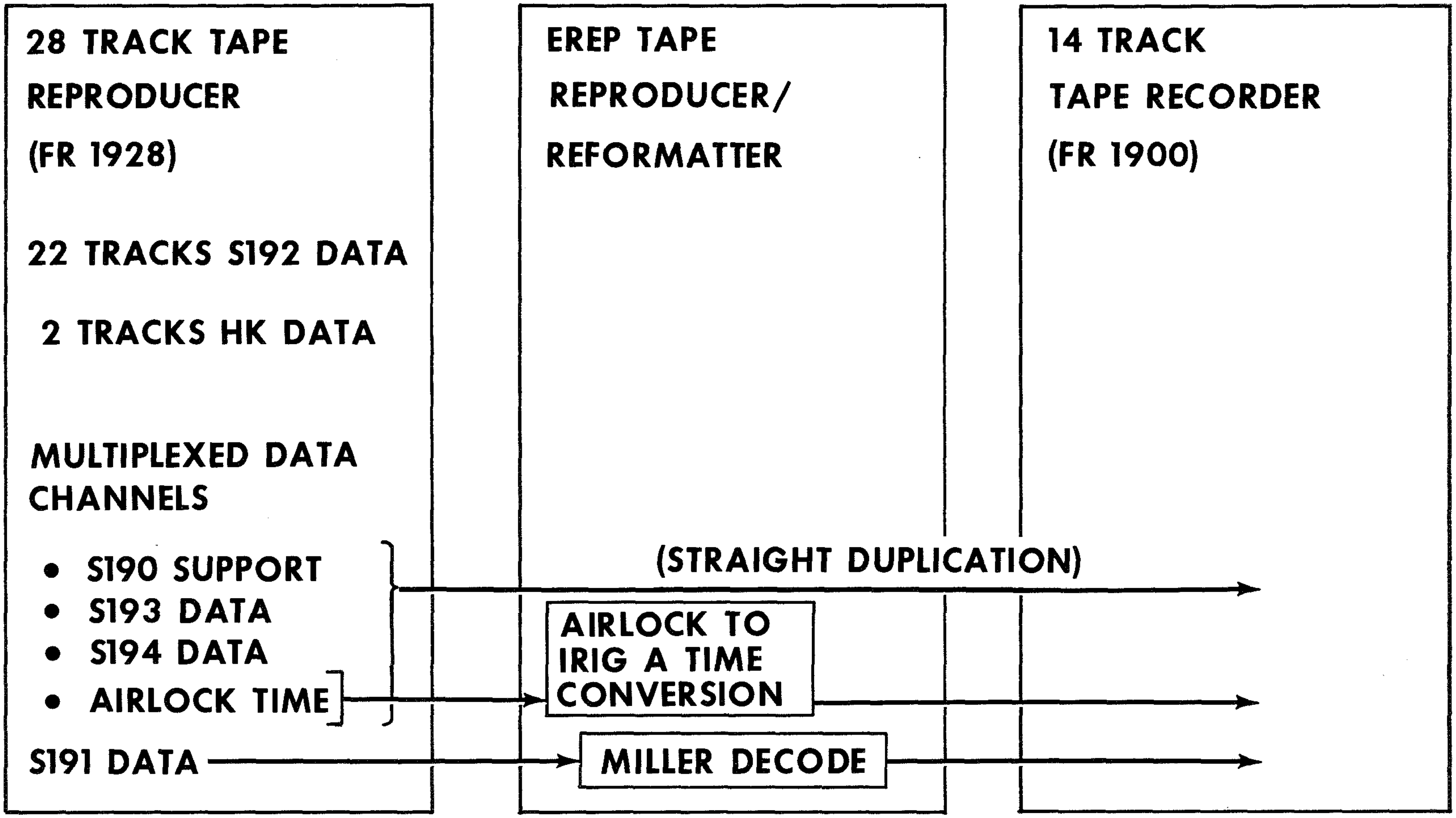
NASA — MSC — Coml., Houston, Texas

NASA-S-71-12920-S

REFORMATTING

FLIGHT TAPE - 28 TRACK, 1 INCH WIDE

FIRST PASS - TO EXTRACT S190, S191, S193 & S194 DATA



28 TRACK TAPE
REPRODUCER
(FR 1928)

22 TRACKS S192 DATA

2 TRACKS HK DATA

MULTIPLEXED DATA CHANNELS

- S190 SUPPORT
- S193 DATA
- S194 DATA
- AIRLOCK TIME

S191 DATA

EREP TAPE
REPRODUCER/
REFORMATTER

(STRAIGHT DUPLICATION)

AIRLOCK TO
IRIG A TIME
CONVERSION

MILLER DECODE

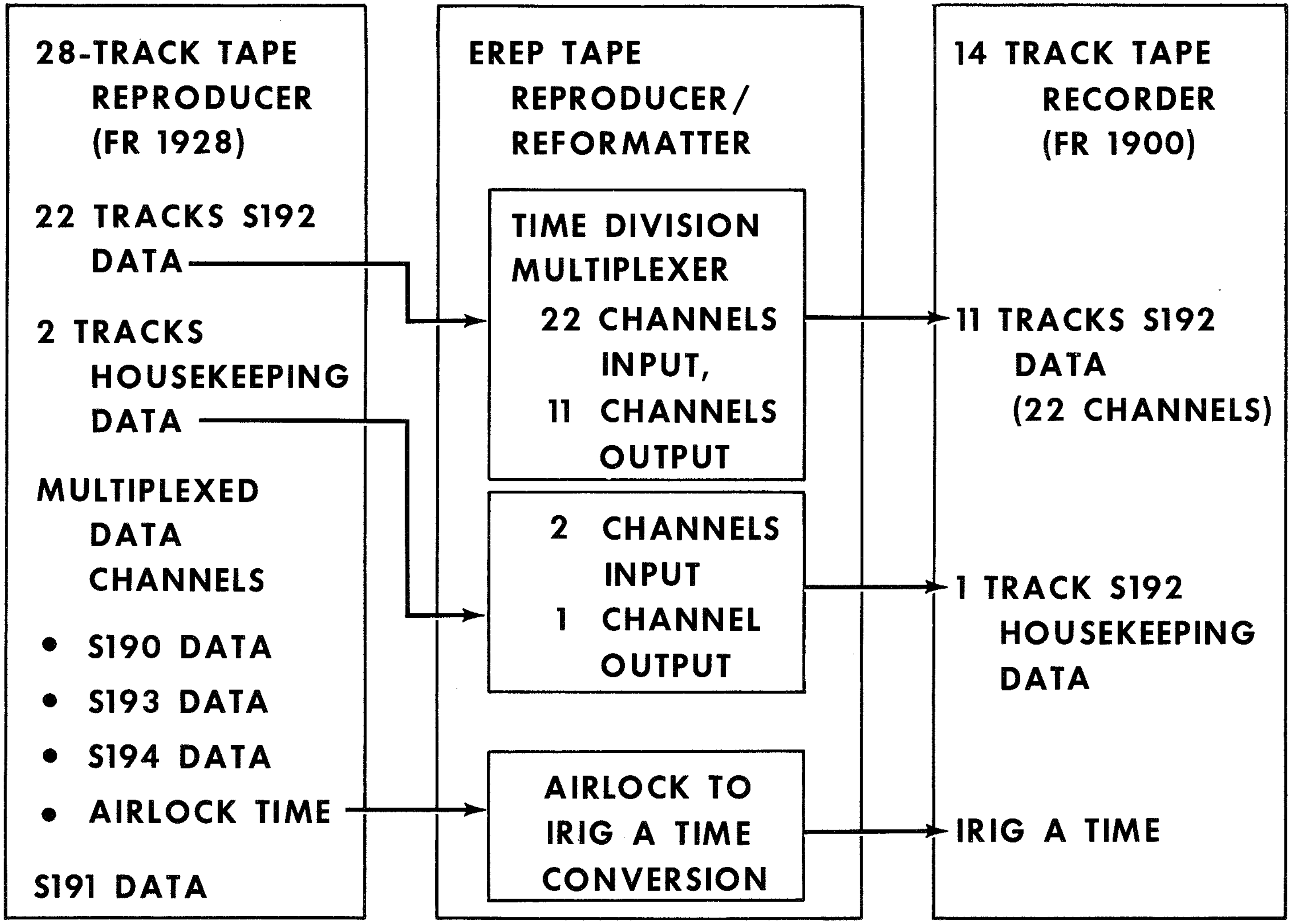
14 TRACK
TAPE RECORDER
(FR 1900)

14 TRACK MASTER TAPES WILL BE FORWARDED TO THE MSC FLIGHT OPERATIONS DIRECTORATE FOR QUICK LOOK AND PRODUCTION DATA PROCESSING

NASA-S-71-12923-V

REFORMATTING

FLIGHT TAPE - 28 TRACK, ONE INCH WIDE
SECOND PASS - TO EXTRACT S192 DATA AND TIME



28-TRACK TAPE REPRODUCER (FR 1928)

22 TRACKS S192 DATA

2 TRACKS HOUSEKEEPING DATA

MULTIPLEXED DATA CHANNELS

- S190 DATA
- S193 DATA
- S194 DATA
- AIRLOCK TIME

S191 DATA

EREP TAPE REPRODUCER/ REFORMATTER

TIME DIVISION MULTIPLEXER
22 CHANNELS INPUT,
11 CHANNELS OUTPUT

2 CHANNELS INPUT
1 CHANNEL OUTPUT

AIRLOCK TO IRIG A TIME CONVERSION

14 TRACK TAPE RECORDER (FR 1900)

11 TRACKS S192 DATA (22 CHANNELS)

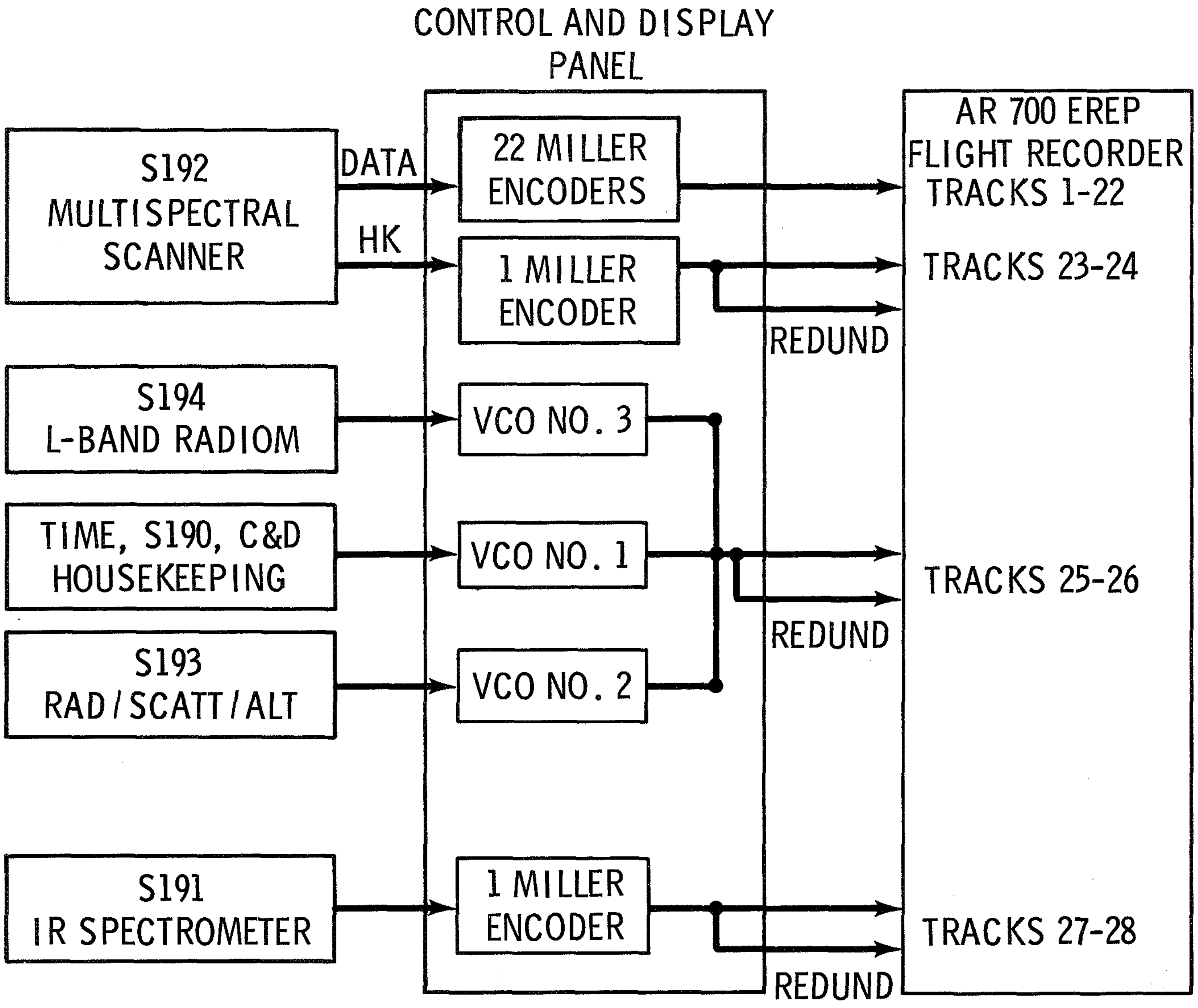
1 TRACK S192 HOUSEKEEPING DATA

IRIG A TIME

14 TRACK MASTER TAPES WILL BE FORWARDED TO MSC SCIENCE AND APPLICATIONS DIRECTORATE FOR SCREENING, PROCESSING FOR QUICK LOOK AND REFORMATTING FOR PRODUCTION PROCESSING

NASA-S-71-12710-V

EREP TAPE RECORDER FORMAT, GENERAL



NASA-S-71-12716-V

DATA PROCESSING TIME

INITIAL HANDLING OF MAGNETIC TAPE DATA

● LOGGING DATA IN AND REVIEW OF MISSION LOGS	2 HOURS
● TAPE REFORMATTING AND REPRODUCTION	35 HOURS
● DISSEMINATE TAPES TO CAAD AND EOD GROUND STATIONS FOR FURTHER PROCESSING	

NASA-S-71-12715-V

DATA PROCESSING TIME

S190, MULTIBAND PHOTOGRAPHIC FACILITY	(1800 FT ORIGINAL FILM) (18 CASSETTES, 100 FT EACH)
● LOGGING-IN TO PHOTOGRAPHIC TECHNOLOGY LAB	1 HOUR
● SENSITOMETRY TESTING	5 HOURS
● INITIAL PROCESSING (WITH SETUP) AND HANDLING	10 HOURS
● SCREENING AND QUALITY CONTROL	20 HOURS
● ANNOTATION	5 HOURS
● DUPLICATION	10 HOURS
● PROCESSING OF 10 POSITIVE AND 10 NEGATIVE FILMS	20 HOURS
● QUALITY CONTROL	5 HOURS
● LOGGING-OUT TO RESEARCH DATA FACILITY	2 HOURS
● CATALOGING, INDEXING, PREPARATION FOR SHIPMENT	15 HOURS
● DISSEMINATION TO INVESTIGATORS	93 WORK HOURS AFTER RECEIPT AT PTL
● PREPARATION OF SELECTED SPECIAL PRODUCTS IN ADDITIVE COLOR VIEWER PRINTER	40 HOURS
● PROCESSING OF SPECIAL PHOTOGRAPHIC PRODUCTS	10 HOURS
● PROCESSING OF SELECTED IMAGES BY USE OF PATTERN RECOGNITION TECHNIQUES	80 HOURS

NASA-S-71-12723-V

DATA PROCESSING TIME

S191, IR SPECTROMETER

● PCM DECOM AND FORMATTING FOR DIGITAL COMPUTER	5 HOURS
● PROCESSING ON DIGITAL COMPUTER (60 KILOBIT DATA)	2 HOURS
● PREPARATION OF OUTPUT PRODUCTS, PLOTS AND TAPES	3 HOURS
● DELIVERY TO RESEARCH DATA FACILITY	10 HOURS AFTER RECEIPT OF TAPE

NASA-S-71-12724-V

DATA PROCESSING TIME

S192, MULTISPECTRAL SCANNER

● RECORD SELECTED SEGMENTS OF DATA FROM ALL BANDS ON FILM FROM BEGINNING, MIDDLE AND END OF EACH TAPE TO BE USED IN SENSOR EVALUATION		10 HOURS
● PREPARE BLACK AND WHITE FILM OF SELECTED DATA BAND (100 PERCENT COVERAGE)		35 HOURS
● PROCESS FILM (IN PTL) (4 ROLLS)		2 HOURS
● DUPLICATE FILM 10 COPIES		4 HOURS
● PROCESS FILM COPIES		8 HOURS
● VISUAL SCREENING OF DATA SELECTION OF TRAINING SAMPLES SELECTION OF TEST SITE DATA		60 HOURS
● FILM AND DIGITAL TAPE RECORDING OF TRAINING SAMPLES AND SELECTED DATA FOR ANALYSIS (10 PERCENT OF DATA) (DIGITAL RECORD 6 BEST BANDS FOR ANALYSIS)	FILM TAPE	35 HOURS 5 HOURS
● TRANSMIT DATA TO RESEARCH DATA FACILITY		3 HOURS
● DISTRIBUTION TO INVESTIGATOR		162 HOURS AFTER RECEIPT OF DATA TAPE

NASA-S-71-12722-V

DATA PROCESSING TIME

S193, RAD / SCATT / ALTIMETER

● PCM DECOM AND FORMATTING FOR DIGITAL COMPUTER	3 HOURS
● PRODUCE PRODUCTS FOR SCREENING AND SENSOR EVALUATION	2 HOURS
● PROCESSING ON DIGITAL COMPUTER (3 TYPES OF DATA)	6 HOURS
● PREPARATION OF PLOTS, TABS AND FILM	3 HOURS
● DELIVERY TO RESEARCH DATA FACILITY	2 HOURS
● DISSEMINATION TO INVESTIGATORS	16 HOURS

NASA-S-71-12721-V

DATA PROCESSING TIME

S194, L-BAND RADIOMETER

● PCM DECOM AND FORMATTING FOR DIGITAL COMPUTER 1K BIT DATA	1 HOUR
● PROCESSING ON DIGITAL COMPUTER	1/2 HOUR
● PREPARATION OF PLOTS, TABS, AND FILM	1 HOUR
● DELIVERY OF RESEARCH DATA FACILITY	2 1/2 HOURS
● DISSEMINATION TO INVESTIGATORS	

COMMENTS CONCERNING PCM DATA PROCESSING

- THE PRECEEDING DATA PROCESSING TIME ESTIMATES DO NOT INCLUDE WAITING TIME BETWEEN PROCESSING FUNCTIONS
- THE SAME PCM PROCESSOR IN CAAD WILL BE USED TO DECOMMUTATE AND FORMAT DIGITAL COMPUTER TAPES FOR ALL EREP DATA EXCEPT S192 DATA
- TWO GROUND DATA STATIONS WILL BE AVAILABLE FOR PROCESSING S192 DATA. (SCREENING, FILM RECORDING, DIGITAL TAPE RECORDING)
- NO PROCESSING TIME BREAKOUT IS PRESENTED FOR PROCESSING AND TABULATING THE TAPE RECORDED ANCILLIARY DATA FOR S190 AS IT IS VERY SMALL

NASA-S-71-13234-V

DATA FACILITIES SERVICES

- EREP TAPE REPRODUCER/REFORMATTER
  - THE ORIGINAL FLIGHT TAPES ARE INCOMPATIBLE WITH EXISTING GROUND DATA PROCESSING FACILITIES IN A NUMBER OF RESPECTS. THE EREP TAPE REPRODUCER/REFORMATTER WILL BE REQUIRED TO CONVERT THE ORIGINAL TAPES TO 14 TRACK MAGNETIC TAPES WHICH ARE COMPATIBLE WITH CENTER FACILITIES
- MSS DATA ANALYSIS STATIONS (DAS)
  - TWO MULTISPECTRAL DATA ANALYSIS STATIONS HAVE BEEN DESIGNED AND PROCURRED BY THE EARTH OBSERVATIONS DIVISION FOR PREPROCESSING, DISPLAYING, SCREENING, FILM RECORDING, AND DIGITAL MAGNETIC TAPE RECORDING. USED PRIMARILY FOR S192 DATA
- FOD/CAAD COMPUTERS AND DATA PROCESSING FACILITIES
  - AFTER ORIGINAL FLIGHT TAPES ARE REFORMATTED AND REPRODUCED ON 14 TRACK ANALOG MASTER TAPES, THE TAPE MASTERS CONTINING DATA FROM EXPERIMENTS S190 (SUPPORTING DATA), S191, S193, AND S194 WILL BE FORWARDED TO FOD FOR DECOMMUTATION AND PROCESSING ON TELEMETRY PROCESSING STATIONS AND COMPUTERS
- PHOTOGRAPHIC TECHNOLOGY LABORATORY (PTL)
  - THE S190 AND S191 FILM WILL BE PROCESSED IN THE MSC PHOTOGRAPHIC TECHNOLOGY LABORATORY
  - PHOTOGRAPHIC LABORATORY EQUIPMENT
    - VERSAMAT PROCESSORS B & W AND COLOR
    - PRINTERS RAINBOW AND NIAGARA
    - ENLARGERS
    - RECTIFIER
    - PAPER PRINTERS
    - SENSITOMETER
    - SENSITOMETRIC PROCESSOR
    - TITLERS

NASA-S-71-12700-V

DATA FACILITIES/SERVICES (CONT)

- EARTH RESOURCES RESEARCH DATA FACILITY
  - THE PURPOSE OF THE EARTH RESOURCES RESEARCH DATA FACILITY IS TO PROVIDE DATA SERVICES FOR THE ENTIRE EARTH RESOURCES SURVEY PROGRAM, INCLUDING EARTH RESOURCES AIRCRAFT, GEMINI, APOLLO, EARTH RESOURCES TECHNOLOGY SATELLITE, AND SKYLAB EREP DATA
- MAPPING SCIENCES LABORATORY (MSL)
  - THE MAPPING SCIENCES LABORATORY HAS SUPPORTED THE LUNAR PROGRAMS IN THE AREAS OF PREPARING MAPS OF THE MOON, MAPS OF POTENTIAL APOLLO LANDING SITES, AND RELATED AREAS. CONSIDERABLE CAPABILITY HAS BEEN DEVELOPED FOR CALIBRATING CAMERA SYSTEMS, SCANNING IMAGES AND CONVERTING THE IMAGE DATA TO QUANTITATIVE DATA. MUCH OF THE EXPERIENCE GAINED IN LUNAR PHOTOGRAPHIC ANALYSIS IS DIRECTLY APPLICABLE TO ANALYSIS OF EARTH ORIENTED DATA
- THE MSL IS ORGANIZED INTO FOUR GROUPS
  - PHOTOGRAMMETRY
  - PHOTOMETRY
  - IMAGE ANALYSIS
  - DATA BANK

DATA FACILITIES/SERVICES (CONT)

- DATA ANALYSIS TECHNIQUES LABORATORY
  - THE EARTH OBSERVATIONS DIVISION'S DATA ANALYSIS TECHNIQUES LABORATORY CONTAINS EQUIPMENT THAT IS NORMALLY EMPLOYED FOR THE PURPOSE OF PERFORMING SMALL RESEARCH AND ANALYSIS TASKS FOR IN-HOUSE INVESTIGATORS ON EARTH RESOURCES DATA. IT IS ALSO USED FOR QUICK-LOOKS ANALYSIS OF AIRCRAFT FUNCTIONAL CHECK FLIGHTS AND SCREENING OF PAST MISSION EARTH RESOURCES MAGNETIC TAPE RECORDED DATA
- MCC DATA FACILITIES
  - THE MCC COMPUTING FACILITIES WILL BE REQUIRED TO SUPPORT MISSION PLANNING FOR EREP AND SIMULATION FOR EREP MISSIONS
  - IT IS NOT PLANNED THAT ANY EREP SENSOR DATA WILL BE TELEMETERED TO THE EARTH IN REAL-TIME OR DURING THE ACTIVE MISSION, BUT ALL DATA WILL BE RECORDED. AFTER THE DATA HAVE BEEN REFORMATTED FROM 28-TRACK TO 14-TRACK ANALOG TAPE IT WILL BE FORWARDED TO FOD FOR PROCESSING THE DATA ON EITHER THE AVAILABLE COMPUTERS IN THE MCC OR IN CAAD, OR ANY OTHER PART OF FOD WHERE COMPUTING AND PROCESSING EQUIPMENT WILL BE AVAILABLE

NASA-S-71-1329I-V

MSC/MSFC SKYLAB MISSION DATA INTERFACE

- PURPOSE
  - THIS AGREEMENT DELINEATES THE DIVISION OF RESPONSIBILITIES, MUTUAL SUPPORT, AND THE INTERFACE PROCEDURES ESTABLISHED BETWEEN MSFC AND MSC IN THE EXECUTION OF THEIR MISSION DATA HANDLING TASKS
- SCOPE
  - THE MISSION DATA INTERFACE RESPONSIBILITIES ADDRESSED HEREIN INCLUDE:
    - MANAGEMENT OF MISSION DATA OPERATIONS
    - DEVELOPMENT OF THE REQUIREMENTS FOR ACQUISITION AND PROCESSING OF MISSION DATA
    - FLOW OF REQUIREMENTS FOR PROCESSING AND DISTRIBUTION OF MISSION DATA
    - FLOW OF RESULTANT DATA
    - INTERFACE MEETINGS AND SINGLE POINTS OF CONTACT

NASA-S-71-13292-V

MSC/MSFC SKYLAB MISSION DATA INTERFACE (CONT)

- ORGANIZATIONAL RESPONSIBILITY
  - THE CENTER SKYLAB PROGRAM OFFICES SHALL SUPPORT THE ESTABLISHMENT OF A CENTRALIZED ORGANIZATIONAL RESPONSIBILITY FOR MANAGEMENT OF MISSION DATA INSOFAR AS IT IS FEASIBLE. FOR SKYLAB THESE ORGANIZATIONS HAVE BEEN ESTABLISHED AS FOLLOWS:
    - MSFC - PM-MO
    - MSC - FOD
  - MSC SHALL BE RESPONSIBLE FOR THE INTERFACE WITH GODDARD SPACE FLIGHT CENTER (GSFC) AND WITH THE MANNED SPACE FLIGHT NETWORK (MSFN) TO DEFINE REQUIREMENTS FOR THE TRANSMITTAL OVER COMMUNICATION LINES OF TELEMETRY, VOICE, TRACKING, TV AND RELATED DATA FROM THE ORBITING CLUSTER VEHICLE. MSC SHALL ACCOMPLISH THE PREPROCESSING OF THOSE ELEMENTS OF DATA AS REQUIRED BY MSFC FOR FURTHER TRANSMITTAL TO MSFC
  - MSC (FOD) AND MSFC (PM-MO) SHALL DEFINE SINGLE POINTS OF CONTACT FOR THE IMPOSITION OF SKYLAB DATA REQUIREMENTS
  - THE MSC AND MSFC ORGANIZATIONS RESPONSIBLE FOR DATA SHALL AGREE ON A MEDIUM OR MEDIUMS WITHIN WHICH TO INTERFACE WITH PRINCIPAL INVESTIGATORS AND OTHER DATA USERS ON DATA REQUIREMENTS AND ASSOCIATED IMPLEMENTATION PROBLEMS

NASA-S-71-13293-V

MSC/MSFC SKYLAB MISSION DATA INTERFACE (CONT)

- REQUIREMENTS FLOW
  - ESTABLISHED METHOD OR METHODS TO BE DEFINED FOR THE LAYING OF REQUIREMENTS BY MSFC AND MSC ON KSC AND GSFC ARE NOT AFFECTED BY THIS AGREEMENT
  - A COMMON MISSION DATA REQUEST FORM (DRF) SHALL BE DEVISED FOR IMPOSITION OF, TRACKING, AND ACCEPTANCE OF DATA REQUIREMENTS. IT IS DESIRABLE THAT A COMMON FORM BE DEVISED FOR INTRA-CENTER USE AS WELL AS FOR INTER-CENTER USE. THE CENTER ORGANIZATIONS RESPONSIBLE FOR MISSION DATA SHALL AGREE ON THE FORMAT. THIS DRF SHALL SUFFICIENTLY DETAIL THE REQUIREMENT TO ENABLE PROPER IMPLEMENTATION BY THE ASSIGNED IMPLEMENTATION ELEMENT
  - THE DATA REQUEST FORM IDENTIFIED IN ABOVE SHALL INCLUDE, IF APPROPRIATE, A SUMMARY EXTRACT OF THE DATA CONTAINED THEREIN. MSC AND MSFC SKYLAB PROGRAM OFFICES SHALL ASSURE THAT THESE EXTRACTS ARE INCORPORATED INTO THE MISSION REQUIREMENTS DOCUMENT (MRD) SUCH THAT THE MRD WILL CONSTITUTE A SINGLE PROGRAM LEVEL REQUIREMENTS PACKAGE AND A RESPONSE ACKNOWLEDGEMENT TO EXPERIMENT PRINCIPAL INVESTIGATORS. PROGRAM LEVEL DATA REQUIREMENTS NECESSARY TO FULFILL SYSTEMS DETAILED TEST OBJECTIVES (DTO'S) SHALL ALSO BE CONTAINED IN THE MRD

NASA-S-71-13294-V

MSC/MSFC SKYLAB MISSION DATA INTERFACE (CONT)

- DATA PRESENTATION, CONTENT, AND DISTRIBUTION
  - MSC AND MSFC CENTRAL DATA ORGANIZATIONS SHALL ESTABLISH A MEANS OF DATA REDUCTION PRIORITIES SUCH THAT ESSENTIAL DATA IS DELIVERED WITHIN THE REQUIRED TIME FRAME. THIS OBJECTIVE MUST BE TRADED OFF AGAINST OPTIMUM COST PROCEDURES AS WELL AS OBJECTIVES WHENEVER SAFETY IS NOT AN ISSUE
  - CONTROL OF DATA RELEASE WILL REMAIN WITH THE CENTER DIRECTORS AND/OR THE SKYLAB PROGRAM OFFICE MANAGERS EXCEPT WHERE SPECIFICALLY DELEGATED
  - DISTRIBUTION OF DATA SHOULD EMPHASIZE SIMPLICITY, SUCH AS THE USE OF U.S. MAIL AND DIRECT DISTRIBUTION FROM PROCESSING ORGANIZATION TO USER
  - CENTER PROGRAM OFFICES WILL ASSURE A MEANS OF DATA DISTRIBUTION AND CONTROL WHICH WILL NO BE DISRUPTED BY PROGRAM OFFICE DISSOLUTION AFTER THE SKYLAB PROGRAM IS COMPLETED

MSC/MSFC SKYLAB MISSION DATA INTERFACE (CONT)

- AUTHORIZATION
  - THE DIRECTORS OF MSC AND MSFC, IN AFFIXING THEIR SIGNATURES HERETO, AUTHORIZE THE MSC FLIGHT OPERATIONS DIRECTOR AND THE MSFC MISSION OPERATIONS OFFICE MANAGER IN COORDINATION WITH CENTER SKYLAB PROGRAM OFFICE MANAGERS TO TAKE SUCH ACTION AS DEEMED NECESSARY TO IMPLEMENT AND EXPEDITE FULL JOINT AND MUTUAL DATA MANAGEMENT. THESE DIRECTORS SHALL PREPARE AMPLIFYING SUBAGREEMENTS TO THIS AGREEMENT AS ARE DETERMINED TO BE NECESSARY

NASA-S-71-13277-V

MSC DATA MANAGEMENT

- THE SKYLAB PROGRAM OFFICE (SPO) WILL RETAIN RESPONSIBILITY FOR OR OTHERWISE DELEGATE THE FOLLOWING DATA MANAGEMENT TASKS
  - ONBOARD RETURNED EQUIPMENT AND SPECIMENS-REQUIREMENTS, DISTRIBUTION PLAN, AND INSURANCE OF SIGNOUT FROM INITIAL RECEIVING STATION (E.G., BONDED WAREHOUSE)
  - PI REPORTS - DEFINITION, SCHEDULE, AND ACCEPTANCE OF REPORTS THE PI IS RESPONSIBLE TO MAKE IN FULFILLMENT OF OBLIGATION TO NASA
  - PHOTOGRAPHIC DATA
    - LAUNCH PHOTO REQUIREMENTS AND DISPOSITION (MSC)
    - ONBOARD PHOTO DISPOSITION (MSC)
  - ASTRONAUT LOG DISPOSITION
  - CALIBRATION DATA COORDINATION - CENTRAL MSC POINT OF CONTACT
  - AUTHORIZING THE EXPENDITURE OF FUNDS FOR IMPLEMENTATION OF SUPPORT AT NON-NASA FACILITIES

NASA-S-71-13279-V

MSC DATA MANAGEMENT (CONT)

- THE FLIGHT OPERATIONS DIRECTORATE (FOD) IS ASSIGNED RESPONSIBILITY FOR THE FOLLOWING DATA MANAGEMENT TASKS
  - MSFN DATA RECOVERY AND DATA STORAGE SYSTEMS (FSD) - PLANNING AND IMPLEMENTATION: SCIENCE AND ENGINEERING EVALUATION DATA COMPRESSION, NOISE EDITING CRITERIA ARCHIVAL TAPES, PROCESSED DATA STORAGE, ETC
  - POST-OPERATIONS DATA HANDLING
    - REQUIREMENTS (FCD) - DEFINITION OF MSC/PI SCIENCE REQUIREMENTS, REVIEW AND INTEGRATE ALL MSC SCIENCE AND ENGINEERING EVALUATION DATA REQUIREMENTS, AND REVIEW AND INTEGRATE ALL MSC/MSFC INTER-CENTER DATA REQUIREMENTS TO BE IMPLEMENTED BY MSC
    - SKYLAB MISSION REQUIREMENTS DOCUMENT (FCD) - PREPARATION OF THE DATA REQUIREMENTS PORTION OF THE MISSION REQUIREMENTS DOCUMENT
    - IMPLEMENTATION (FSC) - REVIEW, DETERMINE, AND MAINTAIN STATUS OF PROPER IMPLEMENTATION FACILITIES (MCC, BLDG 12 DRC, ETC) FOR SATISFYING ALL SKYLAB MISSION DATA REQUIREMENTS: AND SATISFY POST-OPS DATA REQUIREMENTS WITH MCC CAPABILITIES WHERE PRACTICAL

MSC DATA MANAGEMENT (CONT)

- DATA ACQUISITION DURING MISSION (FCD) - DEVELOP INTEGRATED DATA ACQUISITION PLANDAND IMPLEMENT DURING THE MISSION
- PRIORITY CONTROL FOR ACQUISITION AND PROCESSING (FCD) - DEVELOP A PLAN TO SATISFY DOCUMENTED DATA PRIORITIES AND IMPLEMENT DURING THE MISSION
- DATA DISTRIBUTION (FSC) - DEFINE AND REVIEW IMPLEMENTATION PLANS OF SUPPORTING ORGANIZATIONS
- REQUIREMENTS SCHEDULE (FCD) - PREPARATION AND DISTRIBUTION OF THE DATA REQUIREMENTS INPUT SCHEDULE FOR ALL MSC IMPLEMENTED REQUIREMENTS

NASA-S-71-13280-V

MSC DATA MANAGEMENT (CONT)

- COORDINATION
  - EXPERIMENTS OPERATIONS PANEL (FCD) - REVIEW AND COORDINATION OF MSC EXPERIMENT (PI) DATA REQUIREMENTS WILL BE CONDUCTED THROUGH THE EXPERIMENTS OPERATIONS PANEL (EOP) WITH CHAIRMANSHIP PROVIDED BY FCD. PI DATA REQUIREMENTS COORDINATION WILL BE CONDUCTED ONLY ON AN AS REQUIRED BASIS IF NEGOTIATIONS AND/OR TECHNICAL INFORMATION EXCHANGE SHOULD BE NECESSARY
  - FCD WILL PROVIDE THE NECESSARY INTERFACES, AS REQUIRED, TO REVIEW THE ENGINEERING EVALUATION REQUIREMENTS SUBMITTED BY SYSTEMS ENGINEERING ELEMENTS
  - FSD WILL CONDUCT PERIODIC IMPLEMENTATION REVIEWS TO INCLUDE STATUS OF OUTSTANDING REQUIREMENTS, IMPLEMENTATION ASSIGNMENTS, OFFICIAL COMMITMENT OF CENTERS FOR SUPPORT OF IMPLEMENTATION ASSIGNMENTS, MSC/MSFC SYSTEM INTERFACES, ETC
  - FCD WILL CONDUCT PERIODIC DATA REQUIREMENTS STATUS REVIEWS. AFTER SUBMITTAL OF THE FINAL DATA REQUIREMENTS FOR IMPLEMENTATION (LAUNCH MINUS 6 TO 10 MONTHS), FCD WILL BE RESPONSIBLE TO CONDUCT A REVIEW OF THE OPERATIONS PLAN, INCLUDING DATA MANAGEMENT AND GROUND SYSTEMS UTILIZATION WITH THE SPO'S AND OTHER APPROPRIATE ELEMENTS
- ONBOARD RETURNED EQUIPMENT AND SPECIMENS (LRD) - INSURE DELIVERY TO INITIAL RECEIVING STATION

Page intentionally left blank

NASA-S-71-12693-V

CREW ACTIVITIES

Page intentionally left blank

NASA-S-71-12833-V

CREW ACTIVITIES GROUNDRULES

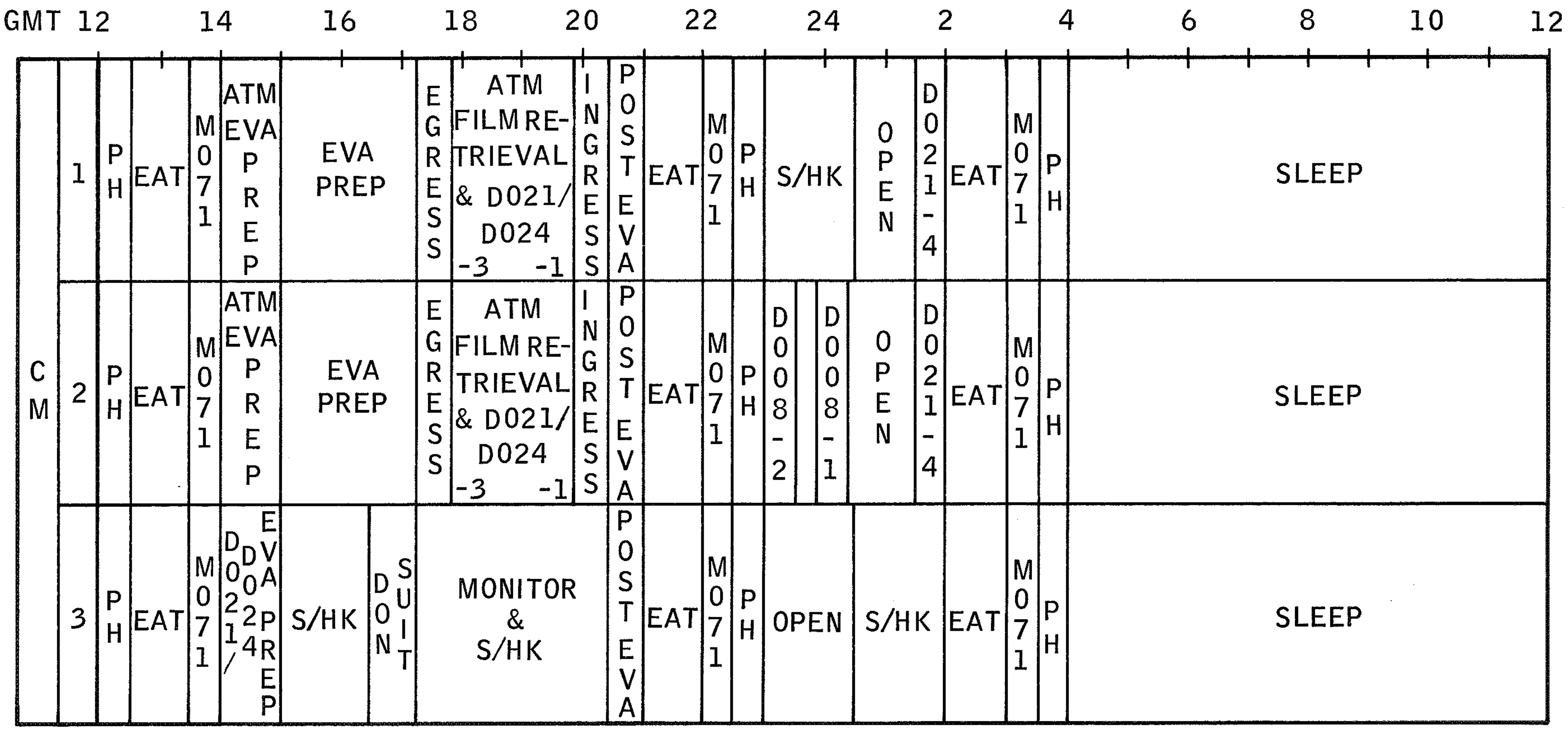
- 8 HOURS SIMULTANEOUS SLEEP PERIOD
- CREW DUTY DAY 6 AM - 10 PM CST
- CREW ACTIVITIES NOT CONSTRAINED BY MSFN COVERAGE
- 3 - ONE HOUR EAT PERIODS PER DAY
- 1.5 HOURS PER MAN PER DAY PERSONAL HYGIENE
- 4.5 HOURS PER DAY - SYSTEM HOUSEKEEPING
- 1 HOUR PER DAY - SIMULTANEOUS MISSION PLANNING / OFF DUTY PERIOD
- EXPERIMENTS, EXCEPT MEDICAL, SCHEDULED ON A 6 DAY PER WEEK BASIS
- SEVENTH DAY (CALENDAR SUNDAY) - R&R, DEBRIEFING, NOMINAL SYSTEMS MONITORING, REGROUP, AND PLANNING
- EAT PERIODS ARE RESCHEDULABLE ± 1 HOUR
- EACH CREWMAN ASSIGNED TO BE EXPERT IN SOME EXPERIMENTS AND EQUALLY PROFICIENT IN ALL SYSTEM OPERATIONS
- ATM FLARE ALARM WILL BE INHIBITED DURING SLEEP PERIODS
- EVA SCHEDULED MAX 3 HRS S / L-2 / ONE EVA, S / L-3 / 3 EVA, AND S / L-4 / 2 EVA
- TWO CREWMEN SUITED PER EVA
- EVA IN SOUTH ATLANTIC ANOMALY WILL BE HELD TO MINIMUM

NASA-S-71-12732-V

EVA DAY

DAY 26

G.E.T. 597:59.2

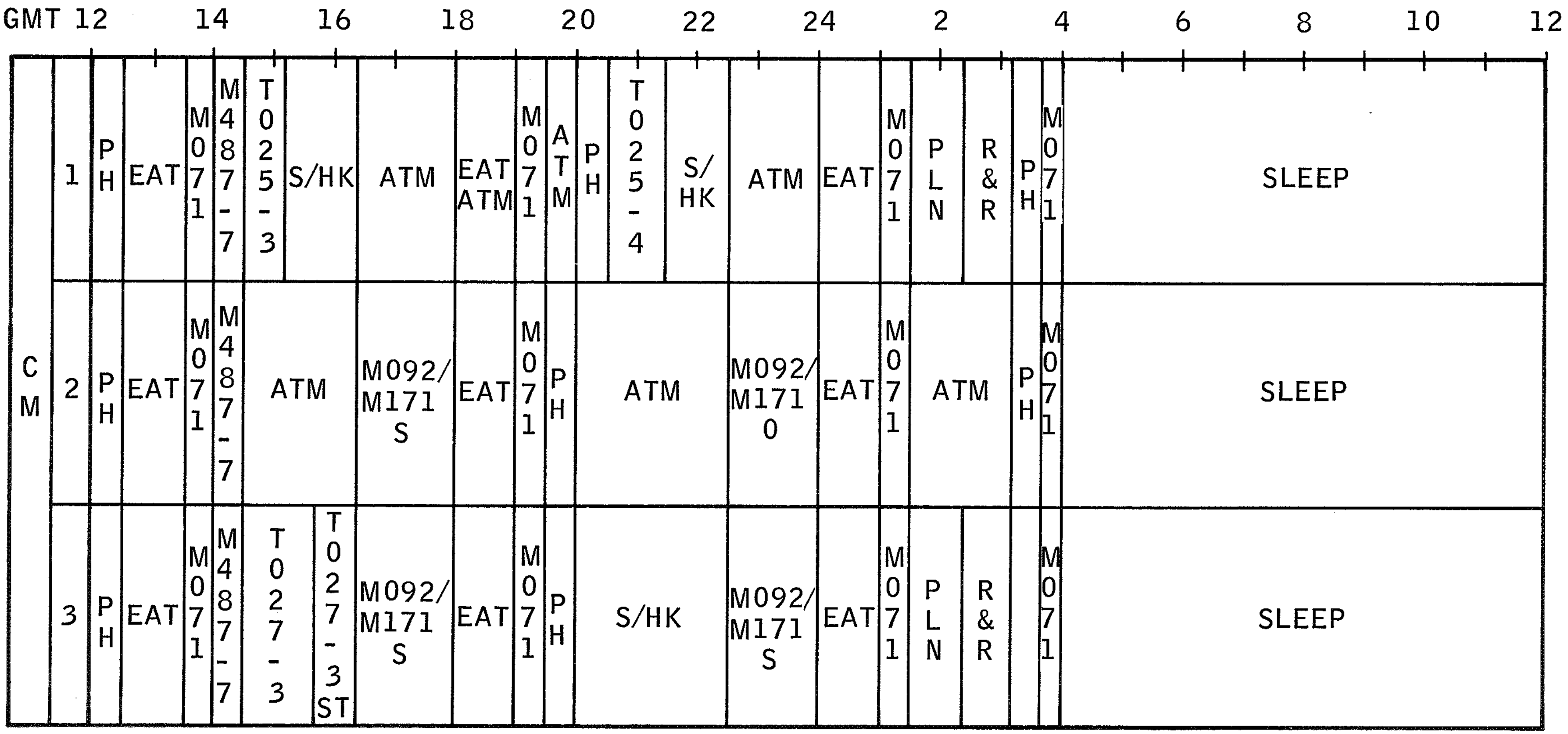


NASA-S-71-12691-V

ATM DAY

DAY 6

G.E.T. 117:59.2

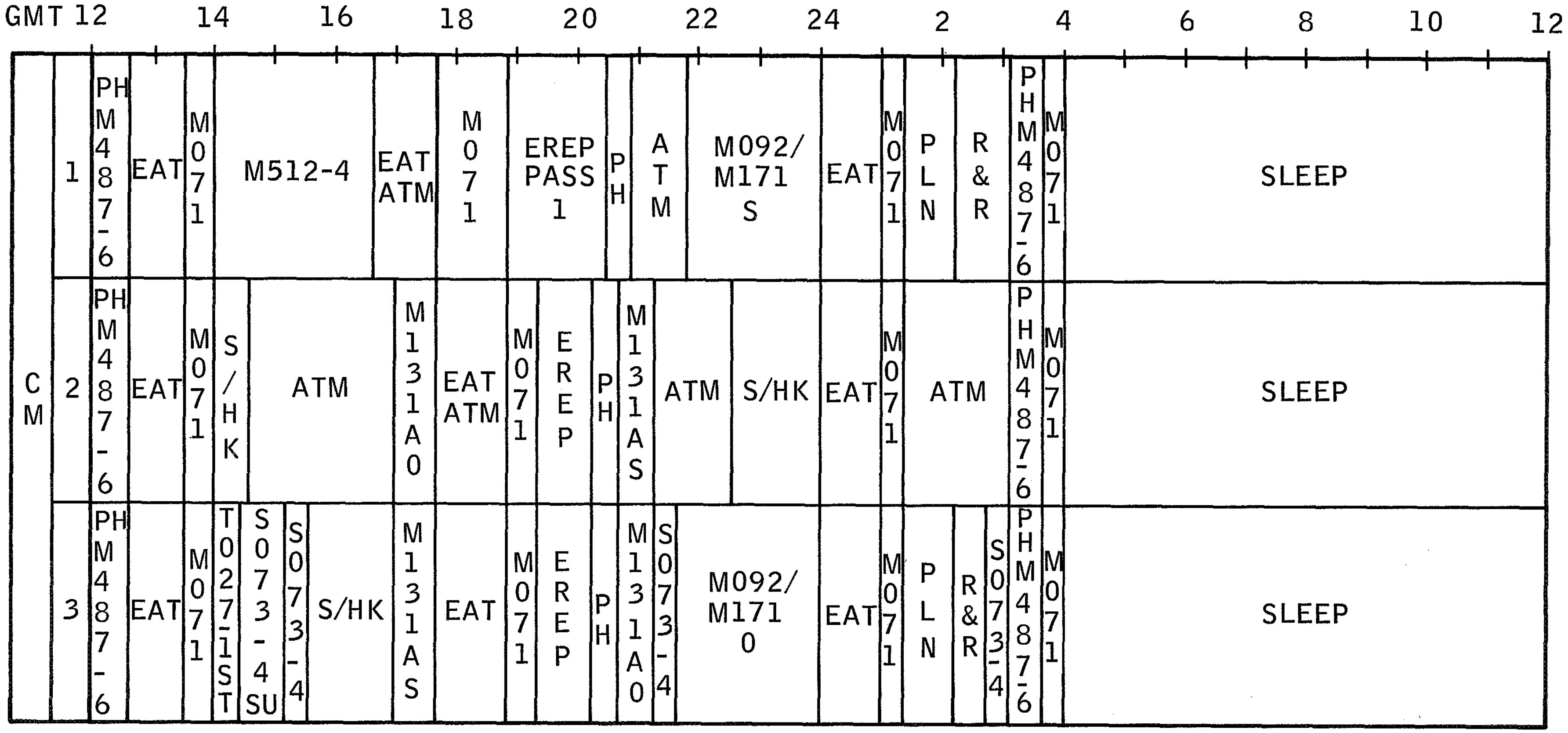


NASA-S-71-12731-V

EREP DAY

DAY 11

G.E.T. 237:59.2



NASA-S-71-12930-S

EREP PAD MESSAGE

EREP PASS NO. XX REV XXX-XXX

12:03:14:40	START SET UP
12:04:14:40	EREP START
12:04:51:50	EREP STOP
12:03:14:40	START HEAT UP/COOL DOWN SEQ
12:03:16:40	T/R REEL NO. 1, CLEAN HEADS
12:03:24:40	START INSTL FILM AND CAMERA SET UP

S 190		
CAMERA	FILTER	f/S
1	AA HH	5.6
2	QQ RR	5.6
3	LL	8.0
4	FF	8.0
5	MM	11.0
6	GG	8.0

FILM SET
A

NASA-S-71-12931-S

EREP PAD MESSAGE (CONT)

39:40	S192 C/O
49:40	S191 C/O
54:40	S193 C/O
59:40	T/R - ON S191 (AUTO CAL)
04:40	T/R - OFF
	START SW SET UP
	EREP - STOP
	T/R PWR - ON
	S192 PWR - ON /STBY OPEN/HI/HI/LO
	S191 PWR - ON/C-6/R-7
	S190 PWR - ON/AUTO/MED/12/8
	S193 R/S PWR - ON/ITC/-/4
	S193 ALT PWR - STBY/1/3/46
	S194 PWR - ON/AUTO/CAL A
14:40	EREP - START
16:30	S190 MODE - OFF/MED/7/8
	S193 MODE - XC/P15/4
	S194 PWR - STBY

EREP PAD MESSAGE (CONT)

20:35	S192	MODE - RDY
20:55	S192	MODE - STBY
22:46	S190	MODE - AUTO
22:55	S192	MODE - RDY
23:15	S192	MODE - STBY
23:45	S192	MODE - OFF/MED/53/8
24:10	S190	MODE - AUTO
	S194	PWR - ON
24:50	S192	MODE - RDY
25:20	S192	MODE - STBY
28:16	S192	MODE - RDY
29:05	EREP	SYS - STOP
	S194	PWR - OFF
	S192	MODE - STBY
30:00	S190	MODE - OFF/MED/5/8
	S193	R/S PWR - STBY IT-C/-/2
	S193	ALT PWR ON
31:05	EREP	START

NASA-S-71-12933-S

EREP PAD MESSAGE (CONT)

36:22	S190	MODE - AUTO
36:30	S193	ALT PWR - OFF R/S PWR - ON
37:00	S190	MODE - OFF /MED/28/8
40:00	S190	MODE - AUTO
41:45	S192	MODE - RDY
42:15	S192	MODE - STBY/PWR - OFF/CLOSED
43:30	EREP	SYS - OFF
	S190	MODE AUTO/MED/9/8
46:30	EREP	SYS - ON
	S191	(AUTO CAL)
47:30	S190	MODE OFF/MED/13/8
50:15	S190	MODE AUTO
	S191	PWR - OFF/COOLER - OFF
51:50	EREP	SYS - OFF
	S190	PWR - OFF/MODE - OFF
	S193	R/S PWR - OFF
		T/R PWR - OFF
		PANEL PWR - OFF
		EREP PWR BUS 1/2 - OFF
52:00	START POST CHECK LIST	

NASA-S-71-13208-S

VTS PAD MESSAGE

12:03:55:00	START SET UP
12:03:59:40	AUTO CAL
12:04:14:40	FIRST TARGET

	TIME	PITCH	ROLL
SITE 146	14:40	45	0
	15:00	30	0
	15:45	0	0
SITE 070	19:36	45	0
	19:57	30	0
	20:40	0	0
SITE 061	21:55	45	2L
	22:25	30	4L
	22:55	0	8L
SITE 128 1P	23:44	45	1R
	24:15	30	2R
	DISP	+2	3R
SITE 128	24:35	20	6R
	25:15	0	8R

	TIME	PITCH	ROLL
SITE 038	27:30	45	1L
	28:03	30	1L
	29:00	0	2L
SITE 123 LEAD -IN	41:00	45	2L
SITE 123	41:34	20	5R
	42:00	0	8R

12:04:46:30	AUTO CAL
12:04:50:15	START POST CHECK LIST

Page intentionally left blank

NASA-S-71-13333-V

GROUND TRUTH

Page intentionally left blank

SKYLAB
GROUND TRUTH GUIDELINES

- EMPLOY PI'S EXISTING GROUND TRUTH CAPABILITY
- UTILIZE EXISTING GROUND TRUTH STATIONS AS MUCH AS POSSIBLE
- DEVELOP GROUND TRUTH SYSTEMS ALONG THE LINES OF EXISTING USER AGENCY, NASA, AND CORPORATE GROUND TRUTH SYSTEMS
- A SKYLAB GROUND TRUTH OFFICE WILL BE ESTABLISHED AT MSC

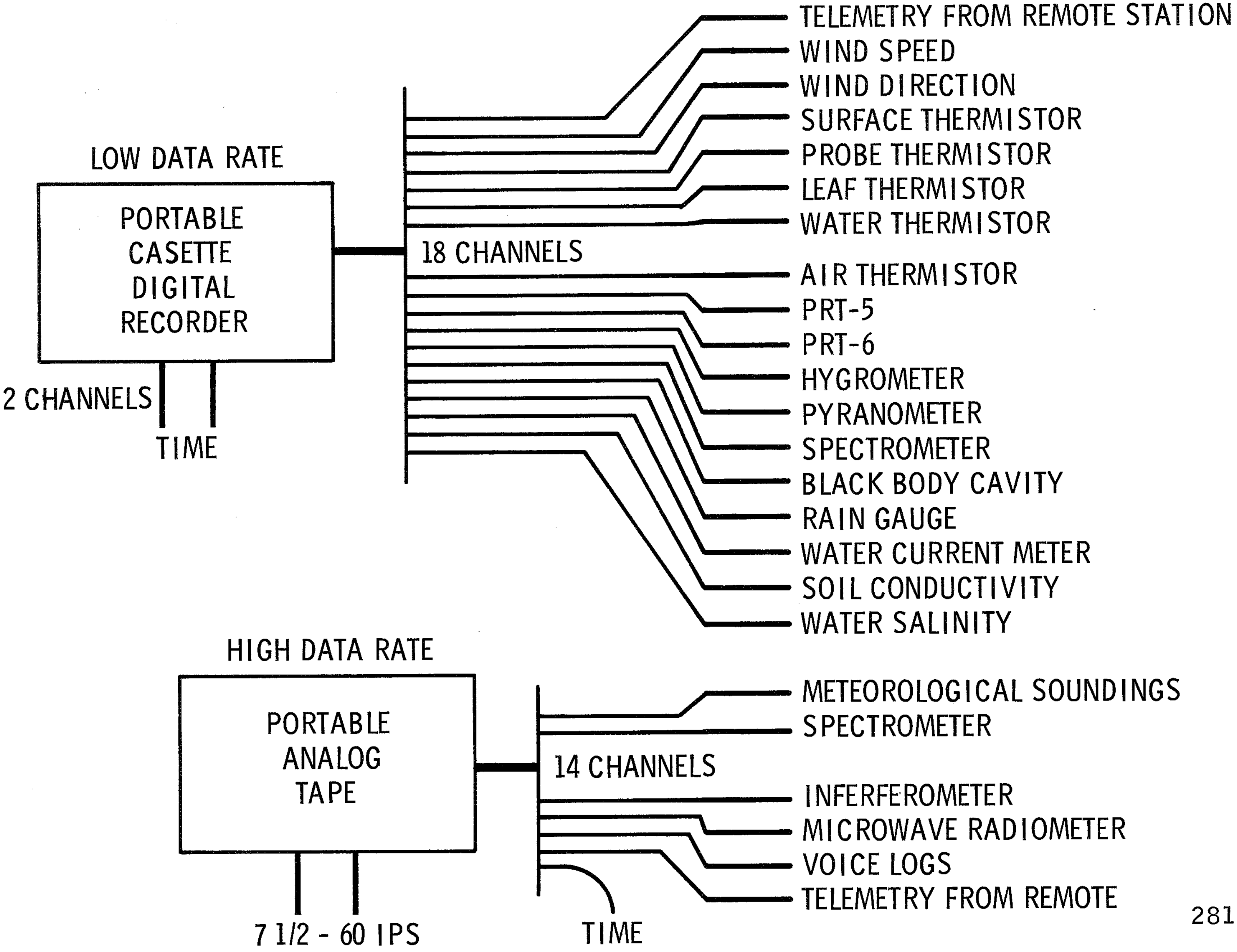
NASA-S-71-13158-V

SUGGESTED GROUND TRUTH MEASUREMENTS

- TARGET REFLECTIVE AND EMISSIVE PROPERTIES
  - SPATIAL PROPERTIES
  - SPECTRAL PROPERTIES
  - THERMAL PROPERTIES
  - HYDRODYNAMIC PROPERTIES
- SITE ENVIRONMENTAL CONDITIONS
  - METEOROLOGICAL
  - HYDROLOGICAL
  - EDAPHICAL
  - GEOMORPHOLOGICAL
- ILLUMINATION CONDITIONS
  - SUN ANGLE
  - CLOUD DISTRIBUTION
  - SPECTRAL DISTRIBUTION OF INCIDENT ENERGY
- PLANT CONDITIONS
  - MATURITY
  - VARIETY
  - PHYSIOLOGICAL CONDITION
    - TURGIDITY
    - NUTRIENT LEVELS
    - DISEASE (VIGOR)
    - HEAT EXCHANGE PROCESSES

NASA-S-71-13198-V

SUGGESTED INSTRUMENTATION EXAMPLE



LOW DATA RATE

PORTABLE
CASETTE
DIGITAL
RECORDER

2 CHANNELS

TIME

18 CHANNELS

- TELEMETRY FROM REMOTE STATION
- WIND SPEED
- WIND DIRECTION
- SURFACE THERMISTOR
- PROBE THERMISTOR
- LEAF THERMISTOR
- WATER THERMISTOR
- AIR THERMISTOR
- PRT-5
- PRT-6
- HYGROMETER
- PYRANOMETER
- SPECTROMETER
- BLACK BODY CAVITY
- RAIN GAUGE
- WATER CURRENT METER
- SOIL CONDUCTIVITY
- WATER SALINITY

HIGH DATA RATE

PORTABLE
ANALOG
TAPE

7 1/2 - 60 IPS

14 CHANNELS

- METEOROLOGICAL SOUNDINGS
- SPECTROMETER
- INFERFEROMETER
- MICROWAVE RADIOMETER
- VOICE LOGS
- TELEMETRY FROM REMOTE

TIME

GROUND TRUTH USER ACTIVITIES

- INFORMATION NEEDED IN EACH PROPOSAL
  - EXISTING INSTRUMENTATION (IN DETAIL)
  - EXISTING DATA REDUCTION FACILITY (IN DETAIL)
  - PROPOSED DATA GATHERING PLAN
  - PROPOSED DATA REDUCTION PLAN
  - PROPOSED DATA FORMATS
  - INSTRUMENTATION AND PLATFORMS (E.G. SHIPS) USER NEEDS BUT DOESN'T HAVE
  - JUSTIFICATION FOR ALL NEEDED INSTRUMENTATION AND PLATFORMS
  - COST ESTIMATES FOR ALL NEEDED INSTRUMENTATION

NASA-S-71-13216-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (TO BE UPDATED BY THE APPROVED INVESTIGATIONS)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
001	LAKE ONTARIO, MDTS	4400-4300N 7900-7700W	
011	CHESAPEAKE BAY, MDTS	3920N-7750W 3940N-7600W 3630N-7430W 3600N-7620W	E-4 E-0-1
012	GREATER WASHINGTON	3910-3838N 7720-7645W	E-4
013	GREATER BALTIMORE	3936-3900N 7645-7620W	E-4
014	UPPER CHESAPEAKE BAY	3900N-7645W 3900N-7620W 3936N-7620W 3936N-7600W 3800N-7645W	E-4
021	SOUTHERN ARIZONA, MDTS	3500N-11230W 3500N-10900W 3120N-10900W 3120N-11100W 3145N-11230W	
022	PHOENIX	3342-3312N 11250-11130W	E-4

(PLANNING INFORMATION ONLY)

NASA-S-71-13217-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
023	WILCOX PLAYA	3214-3203N 11000-10943W	G-1
024	COPPER AREA, ARIZONA	3145N-11050W 15 N MI RADIUS	G-1
031	HOUSTON, MDTS	3100N-9700W 31400N-9450W 2900N-9405W 2800N-9610W	W-4 E-6 L-1
032	GREATER HOUSTON	3000-2933N 9537-9506W	P-2 E-4
033	GALVESTON BAY	2945-2920N 9500-9440W	E-4 L-3
034	HOUSTON SHIP CHANNEL	2946-2938N 9518-9455W	E-4
035	HOUSTON INTERCONTINENTAL AIRPORT	3000-2957N 9521-9518W	E-6
036	JONES STATE PARK	3030-2945N 9545-9500W	F-1
037	SAM HOUSTON STATE PARK	3034-3020N 9550-9500W	E-6

NASA-S-71-13218-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
038	BIG THICKET, TEXAS	3130-3020N 9530-9400W	E-6
041	SOUTHERN FLORIDA, MDTS	2900N-8300W 2900N-8000W 2400N-7930W 2400N-8220W	L-1
042	EVERGLADES, FLORIDA	2544-2510N 8126-8023W	E-7 0-3
051	SALTON SEA, CALIFORNIA	3340N-11620W 3340N-11545W 3310N-11515W 3310N-11550W	E-6 E-7
052	IMPERIAL VALLEY, CALIFORNIA	3310-3230N 11550-11515W	E-4 E-6 E-7
053	OREGON COAST	4622N-12530W 4622N-12430W 4600N-12430W 4600N-12345W 4220N-12345W 4220N-12530W	0-1
054	ATLANTA	3357-3253N 8532-8404W	E-4 F-1

NASA-S-71-13229-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
055	GULF COAST	2750N-9755W 3010N-9430W 2935N-9400W 2730N-9715W 2615N-9710W 2615N-9750W	0-1
056	MISSISSIPPI DELTA	2930-2830N 9030-8930W	0-1 E-4 E-6
059	WIND RIVER, WASHINGTON (SITE 1/4 MILE SQUARE)	4543N-12154W 5 N MI RADIUS	F-1
060	WESLACO, TEXAS	2609N-9757W 10 N MI RADIUS	E-7
061	BONANZA, COLORADO	3835N-10645W 3845N-10615W 3810N-10540W 3750-10615W	E-7 G-1
062	WHITE SANDS, N.M. LAVA BEDS	3355-3315N 10700-10550W	E-6 E-7
063	WHITE SANDS, N.M. DESERT	3305-3240N 10630-10610W	E-6 E-7 L-3 G-1

NASA-S-71-13219-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
064	LAVA BEDS, CALIFORNIA	4140N-12130W 15 N MI RADIUS	G-1 E-6
064	SAN ANTONIO-UVALDE, TEXAS	2900N-3100N 9700W-1000W	L-1
066	BUCCANEER TOWER	2850N-9449W 2 N MI RADIUS	L-3
067	GREAT BARRIER REEF, AUSTRALIA	920S-14340E 920S-14420E 1330S-11420E 1440S-14550E 1600S-14550E 1450S-14525E 1330S-14340E	0-1 0-3
068	LAKE MICHIGAN	4600-4130N 8800-8500W	E-6 E-7
069	LAKE SUPERIOR	4906-4718N 8706-8618	E-7 0-5
070	GREAT SALT LAKE, UTAH	4130-4000N 11300-11400W	L-3 E-2 E-6
071	CRATER LAKE, OREGON	4259-4254N 12210-12202W	E-6
072	PAINTED DESERT	3510-3438N 11000-10940W	E-6

NASA-S-71-13220-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
073	NORTH DAKOTA-MONTANA AREA	5000-4000N 10500-9800W	L-4
074	AUSTRALIA TO N CAPE	2700-2200S 12000-11200E	L-4
075	ARGENTINA PAMPAS	3800-3000S 6300-5700W	L-4
076	PADRE ISLAND, TEXAS	2700N-9735W 2800N-9700W 2700N-9710W 2600N-9710W	E-6 E-7
077	NORTH CAROLINA NOT. SEASHORE	3520-3410N 7550-7500W	E-7
078	NORTH ATLANTIC	5000-4000N 4000-2000W	0-2
079	LAKE LIVINGSTON, TEXAS	3057-3037N 9456-9334W	E-7
080	NILE DELTA	3230-3000N 3230-3000E	E-7
081	OKEEFENOKEE SWAMP, GEORGIA	3130N-8252W 3052N-8106W 2957N-8220W 3051N-8314W	0-3

NASA-S-71-13230-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
082	BOSTON	4234-4210N 7130-7050W	E-4
083	SARAGOSSO SEA	3700-2200N 7600-4000W	0-3
084	TAHITI (LAGOONS AND ATOLLS)	1800-1720S 15000-14900W	0-1 0-3
085	HAWAII	2215N-16030W 2215N-15900W 2000N-15400W 1840N-15500W	0-3
086	JAPANESE COAST	4500N-14200E 4200N-14900E 2800N-13300E 3300N-12700E	0-3
087	PERU COAST	800S-7914W 800S-7840W 1050S-7715W 1050S-7800W	0-3
088	LOS ANGELES, CALIFORNIA	3420-3330N 11900-11800W	P-2 E-4

NASA-S-71-13231-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
089	LAKE ERIE	4200N-8300W 4200N-8200W 4130N-8200W 4230N-8300W	P-2 E-4 E-6
090	GULF STREAM (EASTERN U.S. COAST)	4200N-7000W 4000N-6300W 2400N-7600W 2800N-8200W	0-1 E-6
091	KUROSHIO CURRENT, JAPAN	2405N-12700E 3500N-14200E 3200N-14200E 1700N-12700E	0-1
092	BAHAMAS	2600N-8000W 2800N-7800W 2200N-7000W 2000N-7000W	0-1
093	COLUMBIA RIVER	4620-4605N 12410-12330W	0-1
094	CALIFORNIA COAST	4200N-12700W 4200N-12300W 3300N-11600W 3200N-12200W	0-1

NASA-S-71-13232-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
095	BERMUDA	3230-3210N 6500-6430W	0-1
096	SOUTHWEST U.S.	4000-3000N 1300-1100W	L-2
097	MIDWEST U.S.	4500-3000N 11000-9000W	L-2 E-7
098	NORTH CENTRAL U.S.	5000-4000N 10000-8000W	L-2
099	BUFFALO AREA	4300-4200N 7900-7700W	L-2
100	TEXAS, GULF AREA	3500-2500N 10000-9000W	L-2
101	INTER-TEXAS, GULF AREA	3500-2500N 9800-9200W	L-2
102	PANHANDLE AREA	4000-3500N 10400-9600W	L-2
103	INTER-NORTH CENTRAL U.S.	5000-4000N 9500-9000W	L-2

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
104	UPPER MISSISSIPPI RIVER AREA	4500-4000N 9400-9000W	L-2
105	MATAGORDA BAY	2848-2820N 9640-9610W	L-3
106	TRINITY BAY	2950-2934N 9454-9439W	L-3
107	ATLANTIC	4400N-4100W 4500N-1600W 3500N-4800W 3800N-7100W	0-4
108	CENTRAL GULF OF MEXICO	2900-2500N 9600-8500W	E-2 0-2 L-2 L-3
109	MIDWESTERN ATLANTIC	4000-2000N 7000-5000W	L-2 0-2
110	CENTRAL U.S.	5000-3500N 10000-9000W	L-2 H-1
111	BAJA LAND/SEA INTERFACE	3100N-11800W 3100N-11200W 2400N-10600W 2400N-11300W	E-5

NASA-S-71-13221-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
112	FLORIDA-LAND/SEA INTERFACE	2930N-8400W 2930N-8000W 2530N-7900W 2530N-8300W	E-5
113	VICTORIA DESERT, AUSTRALIA	2700-2000S 13500-12300E	L-4
114	MICHIGAN-COPPER COUNTRY	4600N-8800W 50 N MI RADIUS	G-1
115	SOUTHERN ARIZONA	3100N-3400N 11000W-11300W	L-1
116	COLORADO MOLYBENUM MINES	3914N-10618W 20 N MI RADIUS	G-1
117	AUSTRALIA	4000-1000S 15400-11200E	E-7
118	CANADA	5000-4900N 13000-5500W	E-7
119	BETA NETWORK APRIL-JUNE	3542-3500N 9811-9723W	W-1 W-4
120	CENTRAL U.S. APRIL-JUNE	4000-3400N 10400-9600W	W-1

NASA-S-71-13222-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
121	INDONESIA APRIL-SEPTEMBER	1500N-1050E 0900S-1100E 0-9100E	W-1
122	AFRICA APRIL-SEPTEMBER	1000N-3000E 1000S-2000E 0700N-0700E	W-1
123	SOUTH AMERICA OCTOBER-MARCH	2000S-6500W 0500S-4500W 0200N-8500W	W-1
124	AFRICA OCTOBER-MARCH	3000S-1000E 3000S-5500E 0700S-5500E 0S-1000E	W-1
125	INDONESIA OCTOBER-MARCH	0500S-16000E 2000S-12000E 1000N-9000E 0200N-13500E	W-1
126	AIR SEA INTERFACE, NET FLUX OF WATER	2500N-7500W 2500N-2800W 0-0700W 0-5500W	W-2
127	CORN BELT	4000N-4200W 8600W-9000W	L-1

NASA-S-71-13228-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
128	BLACK HILLS, SOUTH DAKOTA	4430-4345N 10400-10330W	F-1
129	NORTH ISLAND, NEW ZEALAND	4130-3730S 17700-17400E	L-4
130	CENTRAL MADAGASCAR	2500-1500S 4800-4300E	L-4
131	WESTERN U.S.	4500-3700N 11000-10500W	L-4
132	ANDES MOUNTAINS	1200-0000S 7900-7500W	L-4
133	NEWFOUNDLAND	5000-4600N 5900-5300W	L-4
134	WEST U.S. AND MEXICO	4300-3000N 11800-11000W	L-4
135	NORTH HARDWOOD BIOME	4800-4200N 7630-6830W	L-4
136	BUCKS LAKE, CALIFORNIA	4050-3937N 12137-12003W	F-1

NASA-S-71-13223-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
137	PALALOAPAN, MEXICO	1910N-9610W 1830N-9730W 1730N-9640W 1845N-9510W	F-1
138	COPPER AREA, UTAH	4033N-11209W 15 N MI RADIUS	G-1
141	TRI-STATE LEAD AND ZINC OKLA./MO./KANS.	3615N-9600W 130 N MI RADIUS	G-1
142	LAKE OF THE WOODS, ONTARIO (CANADA TO ST. LOUIS)	4920-3839N 9450-9015W	H-2
143	SOUTHERN SASKETCHEWAN (CANADA TO WEST KANSAS)	5000-3700N 10200-1000W	H-2
144	SOUTHERN SASKETCHEWAN (CANADA TO RAPID CITY, S.D.)	5000-4400N 10500-10000W	H-2
145	GREAT FALLS, MONTANA, TO HOUSTON, TEXAS	4730-3000N 11115-10500W	H-2

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
146	PACIFIC OCEAN	5000-3000N 14500-14000W	0-2 0-4
147	ST. LAWRENCE SEAWAY	4500-5000N 6000-6500W	0-5
148	LAKE HURON	4454-4430N 8236-8212W	0-5
149	SENSOR TEST SITE 1	3600N-7500W 5 NM RADIUS	E-1
150	SENSOR TEST SITE 2	4200N-7300W 5 NM RADIUS	E-1
151	SENSOR TEST SITE 3	4700N-8300W 5 NM RADIUS	E-1
152	SENSOR TEST SITE 4	4500N-6200W 5NM RADIUS	E-1
153	SENSOR TEST SITE 5	3500N-7400W 5 NM RADIUS	E-1
154	SENSOR TEST SITE 6	4400N-3500W 5 NM RADIUS	E-1
155	SENSOR TEST SITE 7	2500N-8500W 5 NM RADIUS	E-1
156	SENSOR TEST SITE 8	1000N-8000W 5 NM RADIUS	E-1
157	SENSOR TEST SITE 9	1200N-6000W 5 NM RADIUS	E-1
158	SENSOR TEST SITE 10	2200N-8000W 5 NM RADIUS	E-1

NASA-S-71-13225-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
159	EL PASO AREA	3400-3100N 10800-10500W	E-2
160	PERUVIAN OCEAN CURRENT		E-6
161	GULF OF CALIFORNIA (MOUTH OF COLORADO)	3220-3100N 11510-11400W	E-4
162	METEOR CRATER, ARIZONA	3502-3501N 11102-11101W	E-6
163	EDWARDS AFB, DRY LAKE	3502-3438N 11755-11740W	E-6
164	ILLINOIS SAND DUNES	4140-4100N 8900-8700W	E-6
165	BONNEVILLE SALT FLATS	4040-4030N 11400-11340W	E-6
166	ROSWELL, OIL FIELDS	3400-3200N 10440-10200W	E-6
167	CHINA LAKE, CALIFORNIA	3547-3541N 11740-11735W	E-6
168	HOLLOMAN AFB, NEW MEXICO	3255-3245N 10610-10600W	E-6

NASA-S-71-13226-V

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
169	ALPHA NETWORK		W-4
170	NORTH SHORE, LAKE SUPERIOR	4910-4800N 9000-8400W	W-4
171	HURRICANES-PRIME	4500-1200N 10000-4500W	W-5
172	HURRICANES-U.S. SEC.	3500-1500N 15000-11000W	W-5
173	HURRICANE-NORTH PACIFIC, JUNE-OCTOBER	4500-0500N 17000W-13000E	W-5
174	HURRICANE-NORTH INDIAN OCEAN, JULY-NOVEMBER	3000-0500N 8700-6000E	W-5
175	HURRICANE-SOUTH INDIAN OCEAN, JANUARY-MARCH	4000-0500S 8000-4000E	W-5
176	MOON		E-4 E-6 E-8
177	DEEP SPACE (BLACK)	TBD	E-8
178	DELAWARE ESTUARY	4013-3933N 7550-7530W	E-4
179	HUDSON RIVER, NEW YORK	4120-4020N 7405-7200W	E-4

EARTH RESOURCES EXPERIMENT PACKAGE TEST SITES (CONT)

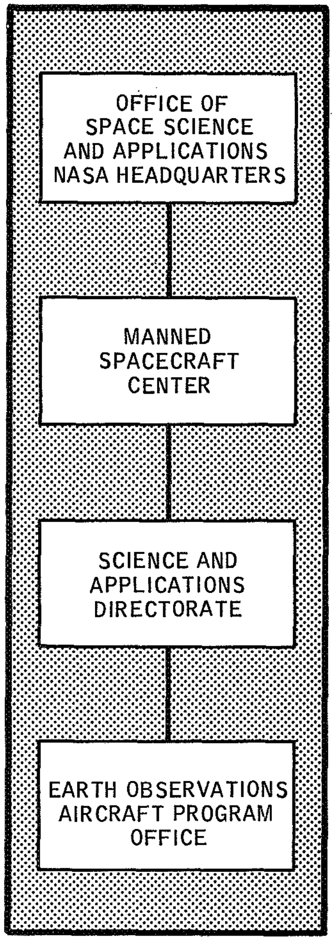
TEST SITE NO.	TEST SITE NAME	COORDINATES (DEG/MIN)	EXPERIMENT NO. (DTO'S)
180	NEW YORK CITY	4100-4033N 7420-7300W	E-4
181	KANSAS WHEAT	3900-3800N 9800-9700W	E-6
182	SIRIUS	TBD	E-8
183	CANOPUS	TBD	E-8
184	MERCURY	TBD	E-8
185	VENUS	TBD	E-8
186	MARS	TBD	E-8
187	JUPITER	TBD	E-8
188	PLUTO	TBD	E-8
189	URANIUS	TBD	E-8
190	NEPTUNE	TBD	E-8
191	SATURN	TBD	E-8
192	STAR FIELD	TBD	E-6

NASA-S-71-13189-V

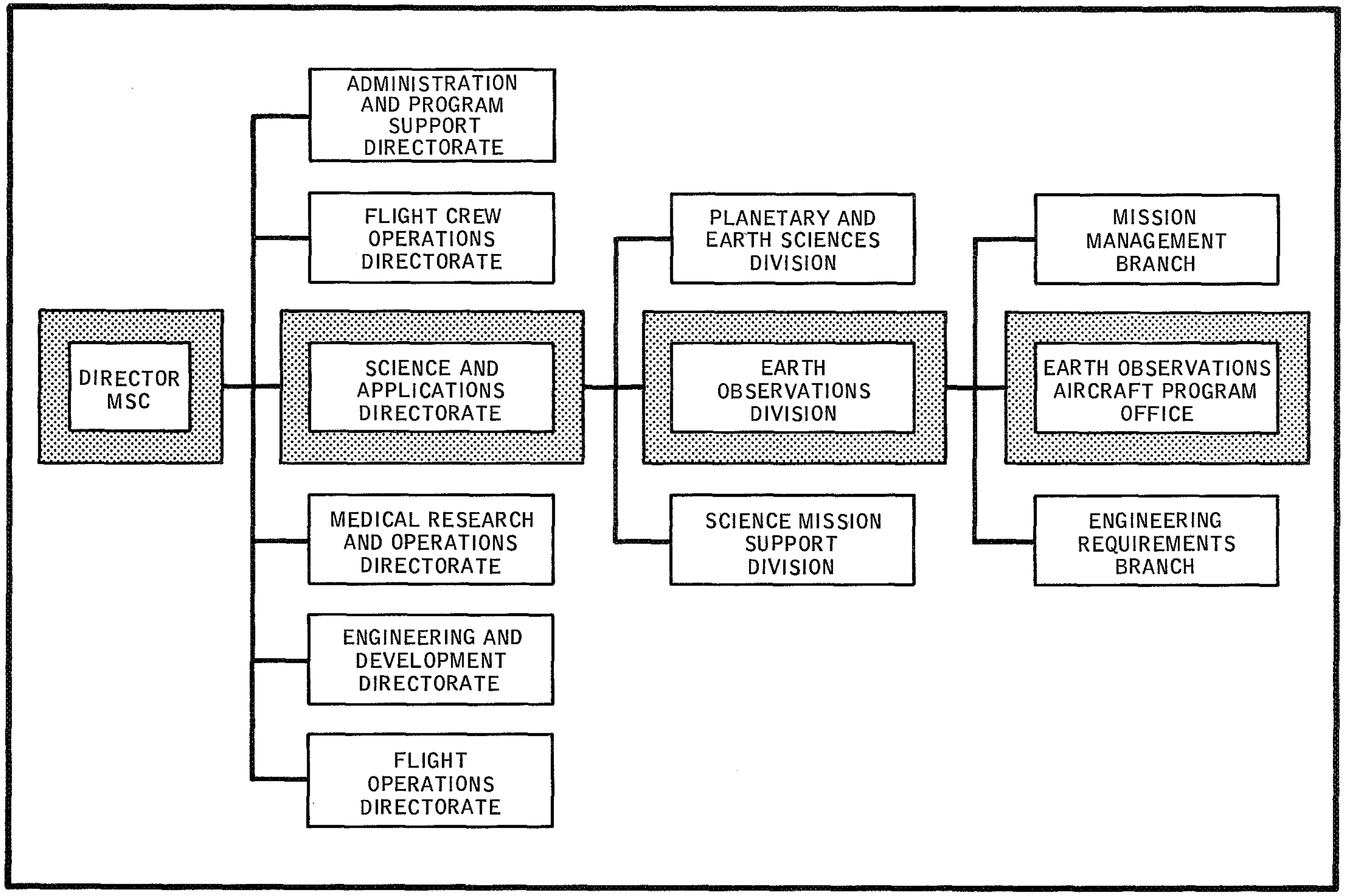
AIRCRAFT SUPPORT FOR SKYLAB EARTH RESOURCE EXPERIMENT PACKAGE

Page intentionally left blank

NASA-S-71-13191-V



FUNCTIONAL STRUCTURE OF THE EARTH OBSERVATIONS AIRCRAFT PROGRAM



NASA/MANNED SPACECRAFT CENTER ORGANIZATIONAL STRUCTURE

NASA-S-71-13327-V

MAJOR PARTICIPANTS IN THE EARTH RESOURCES AIRCRAFT PROGRAM

- NASA OFFICE OF SPACE SCIENCES AND APPLICATIONS
  - DEPARTMENT OF THE NAVY
    - NAVAL OCEANOGRAPHIC OFFICE
    - NAVAL RESEARCH LABORATORY
    - SCRIPPS INSTITUTE OF OCEANOGRAPHY
    - UNIVERSITIES
      - MICHIGAN
      - OREGON STATE
      - NEW YORK
      - KANSAS
      - PUGET SOUND
  - U S DEPARTMENT OF AGRICULTURE
    - FOREST SERVICE
    - AGRICULTURAL RESEARCH SERVICE
    - UNIVERSITIES
      - PURDUE
      - MICHIGAN
      - CALIFORNIA
      - SOUTH DAKOTA STATE
      - MINNESOTA
  - U S DEPARTMENT OF INTERIOR
    - U S GEOLOGICAL SURVEY
    - BUREAU OF COMMERCIAL FISHERIES
    - BUREAU OF LAND RECLAMATION
    - UNIVERSITIES
      - KANSAS
      - MICHIGAN
      - NORTHWESTERN
      - STANFORD
      - DENVER
      - AMERICAN
      - DARTMOUTH
      - GEORGIA
      - FLORIDA ATLANTIC
      - SOUTH DAKOTA STATE
  - INTERNATIONAL PARTICIPATION PROGRAM
  - U S DEPARTMENT OF COMMERCE
    - NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
  - OTHERS
    - NASA CENTERS
    - NATIONAL RESEARCH ANALYSIS CENTER
    - NASA OFFICE OF UNIVERSITY AFFAIRS
      - COLORADO SCHOOL OF MINES
    - NASA MSC RESEARCH CONTRACTS
      - KANSAS
      - MICHIGAN
      - CALIFORNIA
      - STANFORD
      - NEVADA
      - PURDUE
      - JET PROPULSION LAB

NASA-S-71-13336-X

EARTH RESOURCES AIRCRAFT PROGRAM

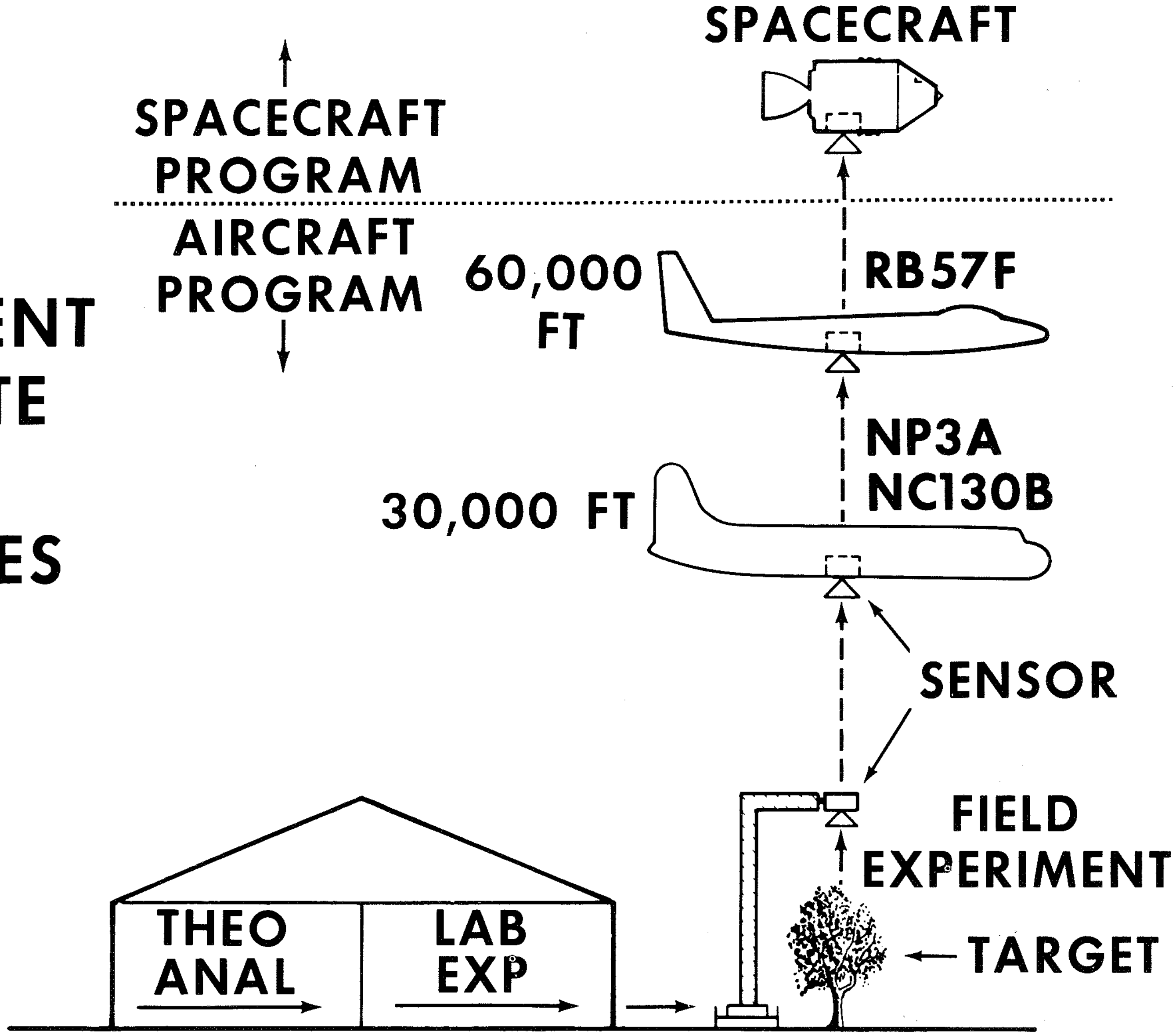
- OBJECTIVE
  - TO DEVELOP REMOTE SENSING TECHNIQUES HAVING POTENTIAL PRACTICAL APPLICATION FOR THE MEASUREMENT OF VARIOUS EARTH CHARACTERISTICS FROM AIRCRAFT OR SATELLITES

- TYPICAL INVESTIGATIONS
  - CROP AND FOREST SURVEY - MULTIBAND PHOTOGRAPHY
  - LAND USE PATTERNS - PHOTOGRAPHY
  - COASTAL HURRICANE DAMAGE ASSESSMENT - PHOTOGRAPHY
  - FISH LOCATION/WATER TEMPERATURE - INFRARED
  - THERMAL WATER POLLUTION - INFRARED
  - AIR/SEA INTERACTION - INFRARED
  - MINERAL IDENTIFICATION - INFRARED
  - SEA-STATE CHARACTERISTICS - MICROWAVE

- SPECIAL PROJECT
  - INTERNATIONAL PARTICIPATION PROJECT (MEXICO, BRAZIL, USA)

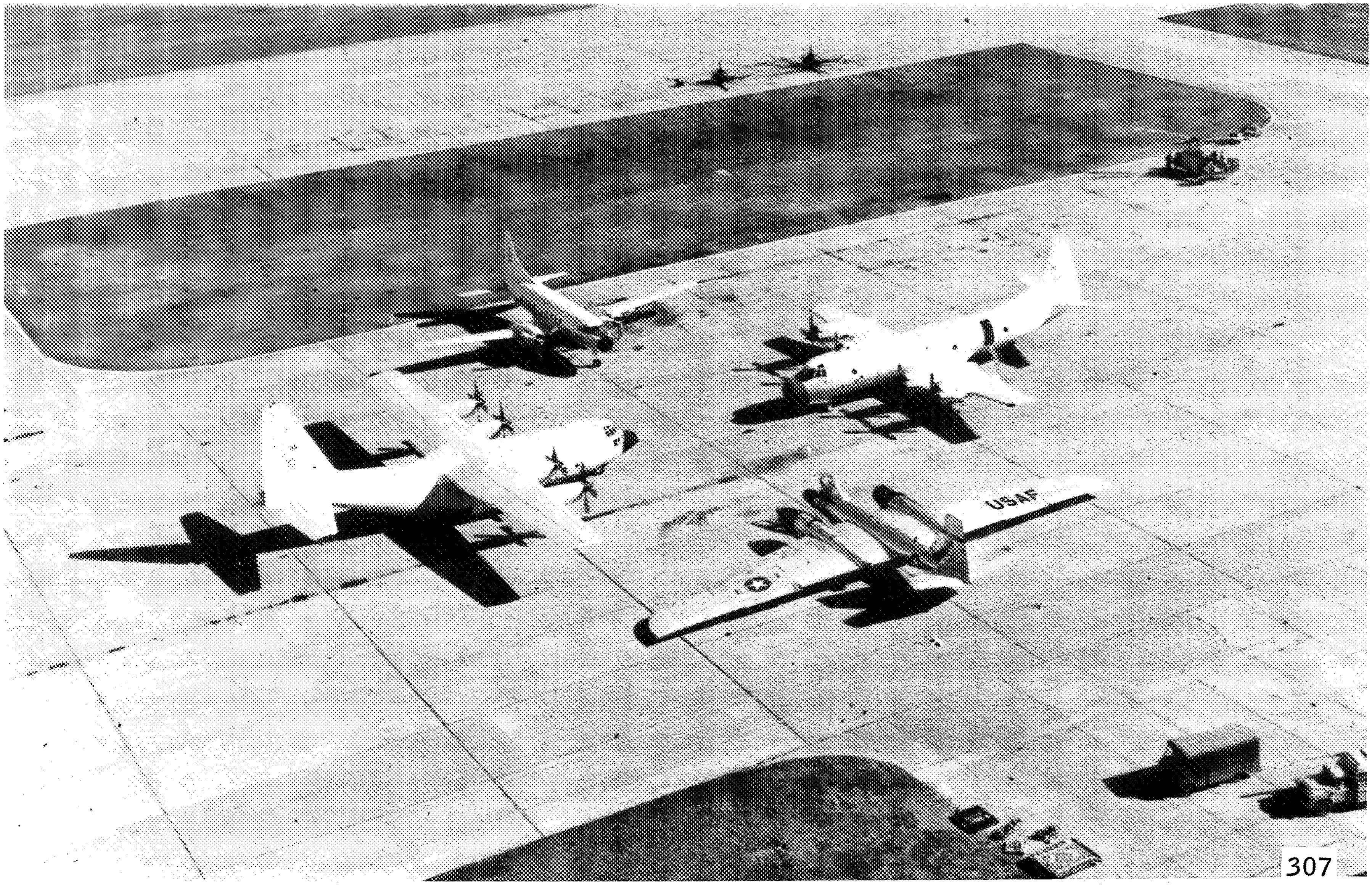
NASA-S-70-14772-X

DEVELOPMENT OF REMOTE SENSOR TECHNIQUES



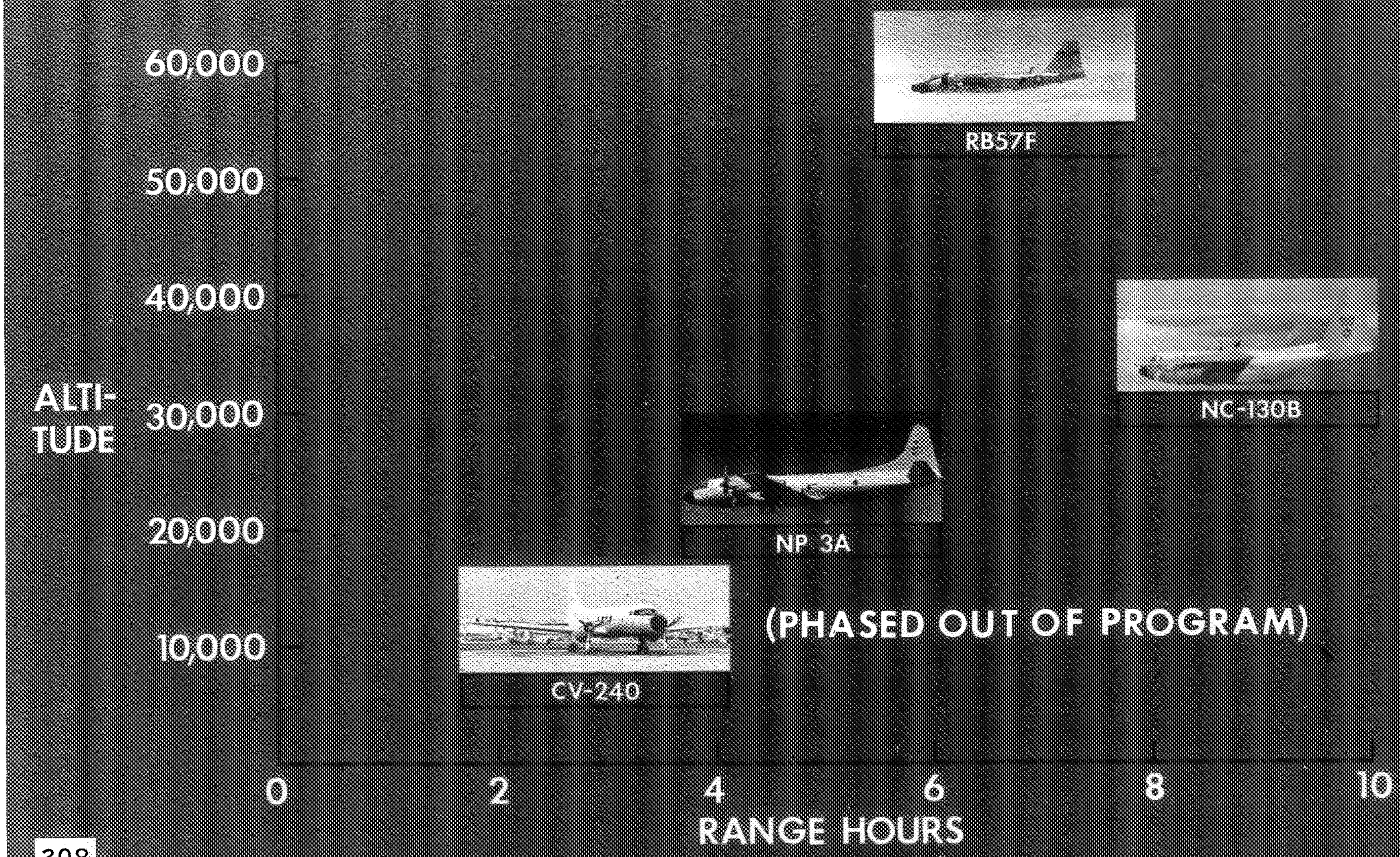
NASA-S-70-13050-X

NASA MSC EARTH RESOURCES AIRCRAFT



NASA-S-71-12703-S

AIRCRAFT CAPABILITIES



NASA-S-71-12995-X

MAJOR ELEMENTS OF AIRCRAFT SUPPORT

- CREW TRAINING AIDS
- TEST SITE DATA BASE
- SENSOR TEST FLIGHTS
- REAL TIME MISSION SUPPORT
- POST MISSION SUPPORT
- AIRCRAFT EQUIPMENT AND SENSORS

NASA-S-71-12996-X

CREW TRAINING AIDS

- OBJECTIVES
    - PROVIDE HIGH ALTITUDE PHOTOGRAPHIC DATA FOR TRAINING USE IN ACQUIRING S191 (INFRARED SPECTROMETER) U. S. A. TEST SITES UTILIZING THE VIEWFINDER TRACKING SYSTEM
    - PROVIDE DATA TO SIMULATE TEST SITE SIZE, TYPE, SEASONAL VARIATIONS, ACQUISITION DISTANCE, WEATHER, ETC
    - SCOPE TEST SITE ACQUISITION AND TRACKING TASKS
- IMPLEMENTATION
    - HIGH ALTITUDE PHOTOGRAPHIC COVERAGE

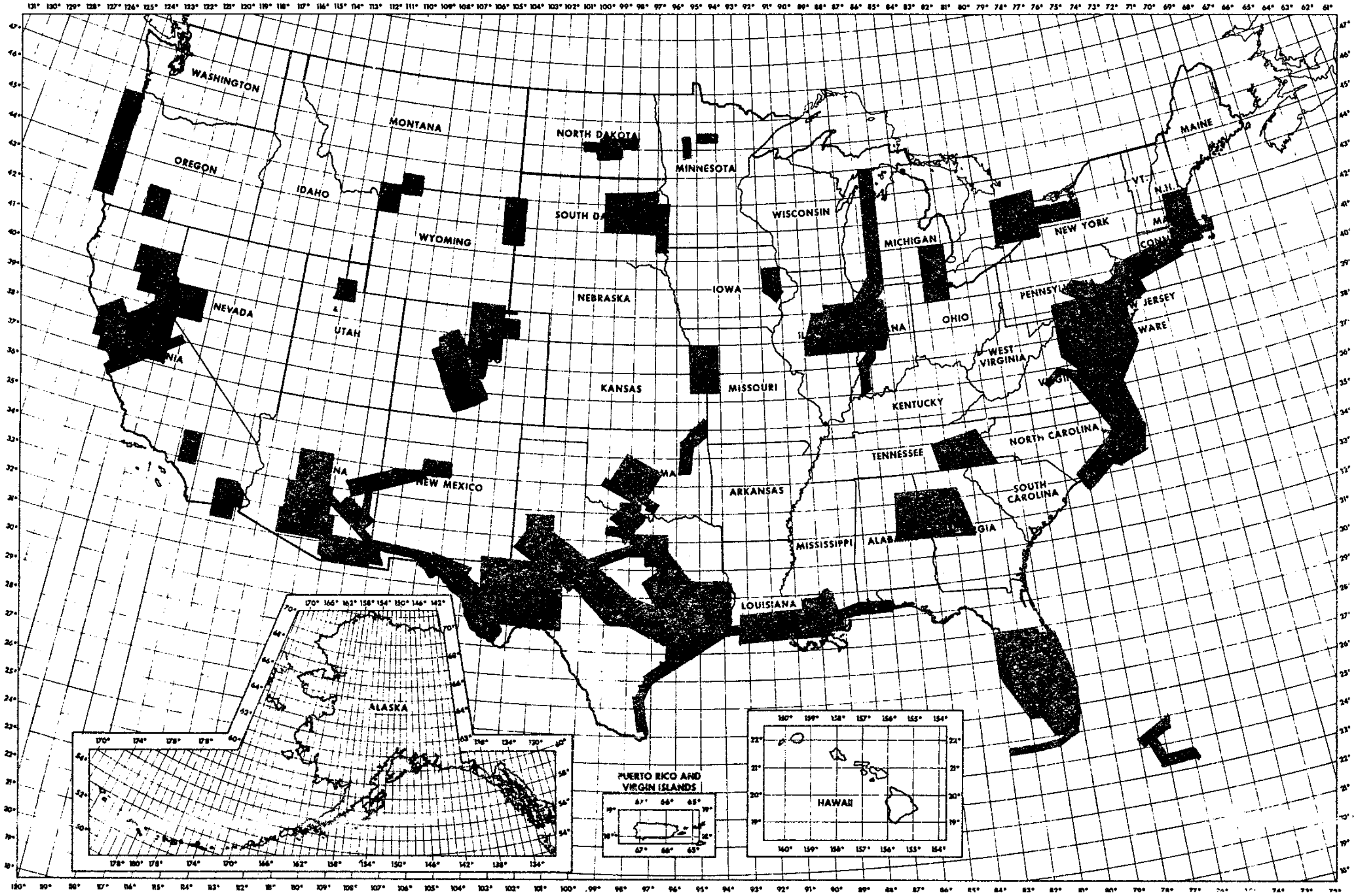
NASA-S-71-12992-X

TEST SITE DATA BASE

- OBJECTIVES
  - OBTAIN BASE LINE <u>TEMPORAL</u> DATA ON SELECTED REGIONAL TEST SITES IN THE U. S. A. FOR ERTS AND SKYLAB
  - CONTINUE <u>BASE LINE</u> DATA GATHERING ON OTHER TEST SITES/REGIONAL AREAS FOR PROGRAM DISCIPLINE REQUIREMENTS
  - IDENTIFY USERS OF SPACE DATA AND PROVIDE PRE-ERTS/PRE-SKYLAB IMAGERY FOR PLANNING AND ANALYSIS
- IMPLEMENTATION
  - HIGH ALTITUDE PHOTOGRAPHIC COVERAGE
  - LOW AND MEDIUM ALTITUDE COVERAGE FOR SELECTED SENSORS/SPECTRAL RANGES

NASA-S-71-13329-V

RB57F COVERAGE
(THRU DECEMBER 1970)



NASA-S-71-12997-X

SENSOR TEST FLIGHTS

- OBJECTIVES
  - FLIGHT TEST OF AIRCRAFT VERSIONS OF SELECTED SPACE SENSORS
  - PROVIDE DATA FOR PLANNING AND ANALYSIS IN FORMATS AND SPECTRAL RANGES COMPATIBLE WITH SPACE SENSORS
  - PROVIDE PRE-SPACE GROUND TRUTH DATA FOR SPECIFIC INSTRUMENTS AND SELECTED TEST SITES TO AID IN INTERPRETATION AND ANALYSIS OF SPACE DATA

- IMPLEMENTATION
  - HIGH ALTITUDE COVERAGE WITH AIRCRAFT S190 CAMERA SYSTEM
  - MEDIUM AND HIGH ALTITUDE TEST FLIGHTS WITH OTHER SPACE SENSOR (AIRCRAFT UNITS) TO BE PLANNED AS AVAILABILITY IS DETERMINED AND PROGRAMMED
  - HIGH ALTITUDE PHOTOGRAPHIC COVERAGE WITH ERTS SPECTRAL BANDS (CAMERA COVERAGE)

NASA-S-71-12993-X

REAL TIME MISSION SUPPORT

- OBJECTIVES
  - TO PROVIDE AIRCRAFT DATA ON A SIMULTANEOUS BASIS IN SPECTRAL BANDS SIMILIAR TO ERTS AND SKYLAB SPACECRAFT SENSORS
  - PROVIDE INFORMATION AND DATA FOR STAGED SAMPLING INVESTIGATIONS
  - TO PROVIDE NECESSARY SUPPORT BETWEEN GROUND TRUTH AND SPACECRAFT DATA MEASUREMENTS FOR FUTURE ANALYSIS
- IMPLEMENTATION
  - HIGH ALTITUDE PHOTOGRAPHIC AND SELECTED SENSOR COVERAGE
  - LOW AND MEDIUM ALTITUDE COVERAGE OF MOST SPACECRAFT MEASUREMENTS

NASA-S-71-12998-X

POST MISSION SUPPORT

- OBJECTIVES
  - CONTINUED TEMPORAL DATA OVER SELECTED SITES FOR CONTINUING INVESTIGATIONS IN ERTS AND SKYLAB
  - ACQUIRE ADDITIONAL OR SUPPLEMENTARY DATA ON AREAS OF INTEREST DETERMINED BY ANALYSIS OF SPACE DATA
- IMPLEMENTATION
  - LOW/MEDIUM AND HIGH ALTITUDE COVERAGE

NASA-S-71-12964-X

AIRCRAFT EQUIPMENT AND SENSORS

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● PHOTOGRAPHIC		
• METRIC		
– RC8-6 IN. FL (9 IN. FORMAT)	COLOR, COLOR IR	NP3A, NC130B, RB57F
– ZEISS-12 IN. FL (9 IN. FORMAT)		RB57F
• MULTIBAND		
– KA62 - 3 IN. FL (5 IN. FORMAT)	B&W, B&W IR, COLOR, COLOR IR	NP3A, NC130B,
– HASSELBLAD-40mm TO 500 mm FL (70mm FORMAT)		NC130B, RB57F
• BORESIGHT		
– 25mm TO 200mm FL (35mm FORMAT)	B&W, COLOR	NP3A, NC130B, RB57F

NASA-S-71-12963-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● INFRARED/ ULTRAVIOLET		
• MULTISPECTRAL SCANNER (IMAGER)	0.34 TO 13μm - 24 DISCRETE SPECTRAL INTERVALS	NC130B (FUTURE SYSTEM)
• MULTISPECTRAL SCANNER (IMAGER)	0.4 TO 2.6μm 13 CHANNELS 1.0 TO 14μm 4 CHANNELS	C47 (UNIVERSITY OF MICHIGAN)
• DUAL CHANNEL SCANNER (IMAGER)	0.3 - 5.5μm 8 - 14μm	NP3A

NASA-S-71-12991-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● INFRARED/ULTRAVIOLET (CONT)		
• INFRARED SCANNER (IMAGER)	8 - 14μm	RB57F
• INFRARED SCANNER (IMAGER)	8 - 14μm	NC130B
• FILTER WHEEL SPECTROMETER	6.7 TO 13.2μm	NP3A OR RB57F
• INFRARED RADIOMETER	10.375 TO 12.1μm	NP3A OR RB57F
• PRECISION RADIATION THERMOMETER	8 - 14μm	NP3A, NC130B

NASA-S-71-12959-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● PASSIVE MICROWAVE		
• MULTIFREQUENCY MICROWAVE RADIOMETER (DUAL POLARIZATION)	1.420 GHz 10.625 GHz 22.235/ 22.355 GHz 31.4 GHz	NP3A
• PASSIVE MICROWAVE IMAGING SYSTEM (DUAL POLARIZATION)	10.69 GHz	NP3A (FUTURE SYSTEM)

NASA-S-71-12960-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● ACTIVE MICROWAVE		
• SIDE LOOKING RADAR (DUAL POLARIZED)	16.5 GHz	NP3A
• SCATTEROMETER (SINGLE POLARIZED)	13.3 GHz	NP3A OR NC130B
• SCATTEROMETER (DUAL POLARIZED)	13.3 GHz	NP3A OR NC130B (FUTURE SYSTEM)
• SCATTEROMETER (DUAL POLARIZED)	400 MHz	NP3A

NASA-S-71-12961-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● LASER • PROFILER	6328A° (HELIUM-NEON)	NP3A OR NC130B
● ENVIRONMENTAL		
• LIQUID H_2O CONTENT		NP3A, NC130B
• TOTAL AIR TEMPERATURE		NP3A, NC130B
• DEW POINT HYGROMETER		NP3A, NC130B

NASA-S-71-12958-X

AIRCRAFT EQUIPMENT AND SENSORS (CONT)

SENSOR TYPE	SPECTRUM/ FREQUENCY	AIRCRAFT
● NAVIGATION/ SUPPORT		
• INERTIAL SYSTEM		NP3A, NC130B, RB57F (FUTURE)
• RADAR ALTIMETER		NP3A, NC130B, RB57F
● DATA SYSTEMS		
• DATA ANNOTATION	MISSION, TIME, DATE, AIRCRAFT PARAMETERS, SENSOR	NP3A, NC130B, RB57F
• DATA RECORDING	MAGNETIC TAPE STRIP CHART	NP3A, NC130B

NP3A SENSOR COMPLEMENT

- PHOTOGRAPHIC SENSORS
  - 2 METRIC CAMERAS
  - 4 MULTIBAND CAMERAS
  - 3 BORESIGHT CAMERAS
- INFRARED SENSORS
  - 1 DUAL-CHANNEL SCANNER
  - 1 SPECTROMETER
  - 1 RADIOMETER
  - 1 RADIATION THERMOMETER
- RADAR SENSORS
  - 1 SIDE LOOKING IMAGING RADAR
  - 2 RADAR SCATTEROMETERS
- MICROWAVE SENSORS
  - 1 MULTIFREQUENCY RADIOMETER
  - 1 IMAGING RADIOMETER (PLANNED 1971)
- LASER SENSOR
  - 1 LASER PROFILER

NASA-S-71-12837-S

NC130B SENSOR COMPLEMENT

- PHOTOGRAPHIC SENSORS
  - 2 METRIC CAMERAS
  - 6 MULTIBAND CAMERAS
  - 3BORESIGHT CAMERA
- INFRARED SENSORS
  - 1 IR SCANNER
  - 1 PRECISION THERMOMETER
  - 1 MULTISPECTRAL SCANNER (PLANNED 1971)
- RADAR SENSORS
  - 1 RADAR SCATTEROMETER

NASA-S-71-12838-S

RB57F SENSOR COMPLEMENT

- PHOTOGRAPHIC SENSORS
    - 3 METRIC CAMERAS
    - 6 MULTIBAND CAMERAS
    - 1 BORESIGHT CAMERA
- INFRARED SENSORS
    - IR SCANNER
    - IR SPECTROMETER
    - IR RADIOMETER

NASA-S-71-12719-V

AIRCRAFT PROGRAM SUPPORT FACILITIES

- AIRCRAFT MAINTENANCE FACILITIES (FCOD)
- RESEARCH DATA FACILITY (EOD)
- SENSOR MAINTENANCE AND CALIBRATION LABS (E&DD)
- DATA EVALUATION AND WAVE ANALYSIS LABS (EOD)
- PRECISION PHOTO PROCESSING LAB (PTD)
- PRODUCTION COMPUTERS (FOD)
- METEOROLOGICAL SUPPORT FACILITY (SMG)

NASA-S-71-13159-V

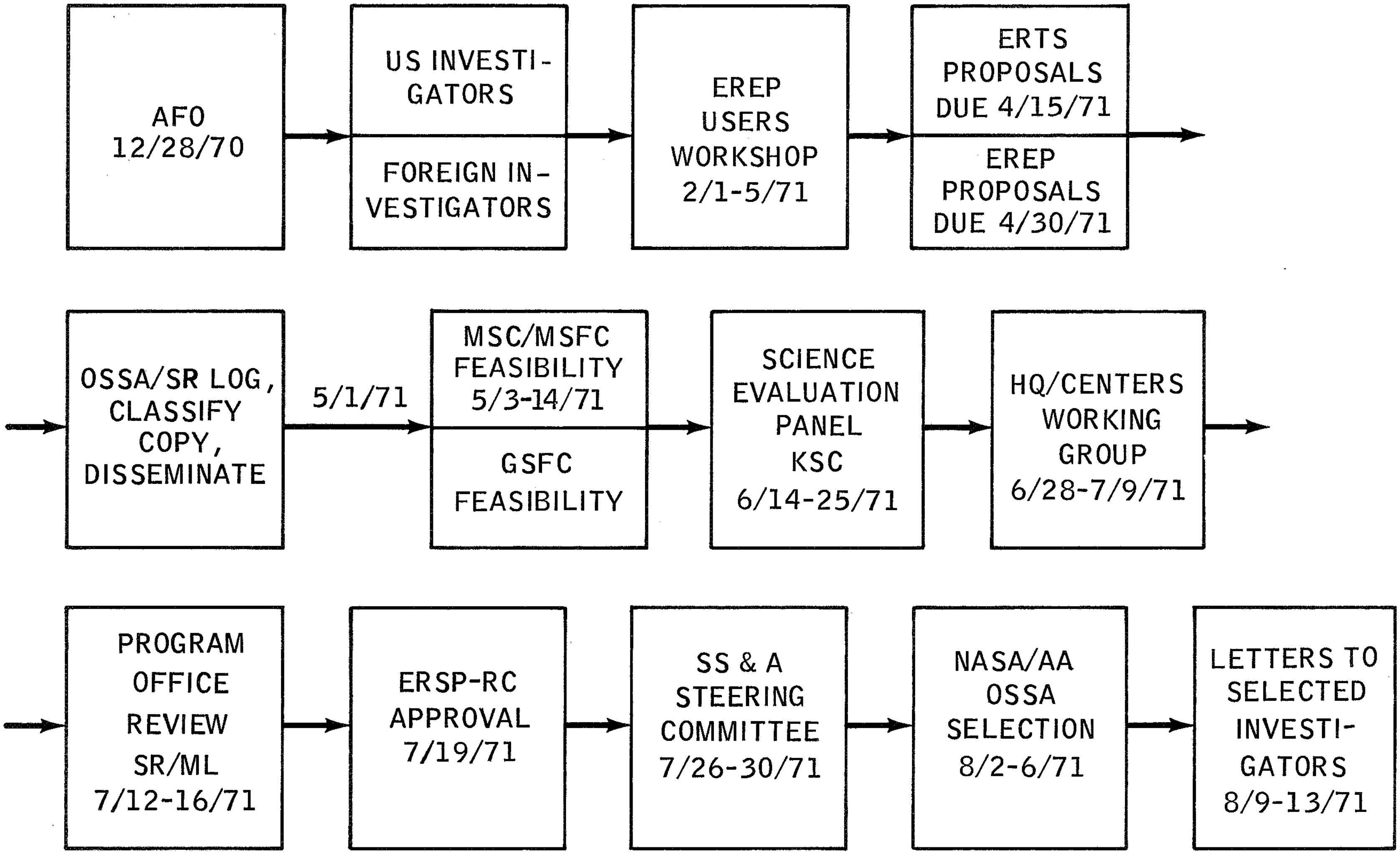
PROPOSAL PREPARATION

NOTE: REFERENCE JOINT ERTS/EREP
PROPOSAL INSTRUCTION DOCUMENT
AVAILABLE FROM:
MR THOMAS RAGLAND
GODDARD SPACEFLIGHT CENTER CODE 430
GREENBELT, MD 20771

NASA-S-71-13192-V

ERTS/EREP PROPOSAL FLOW

REVISED/TENTATIVE

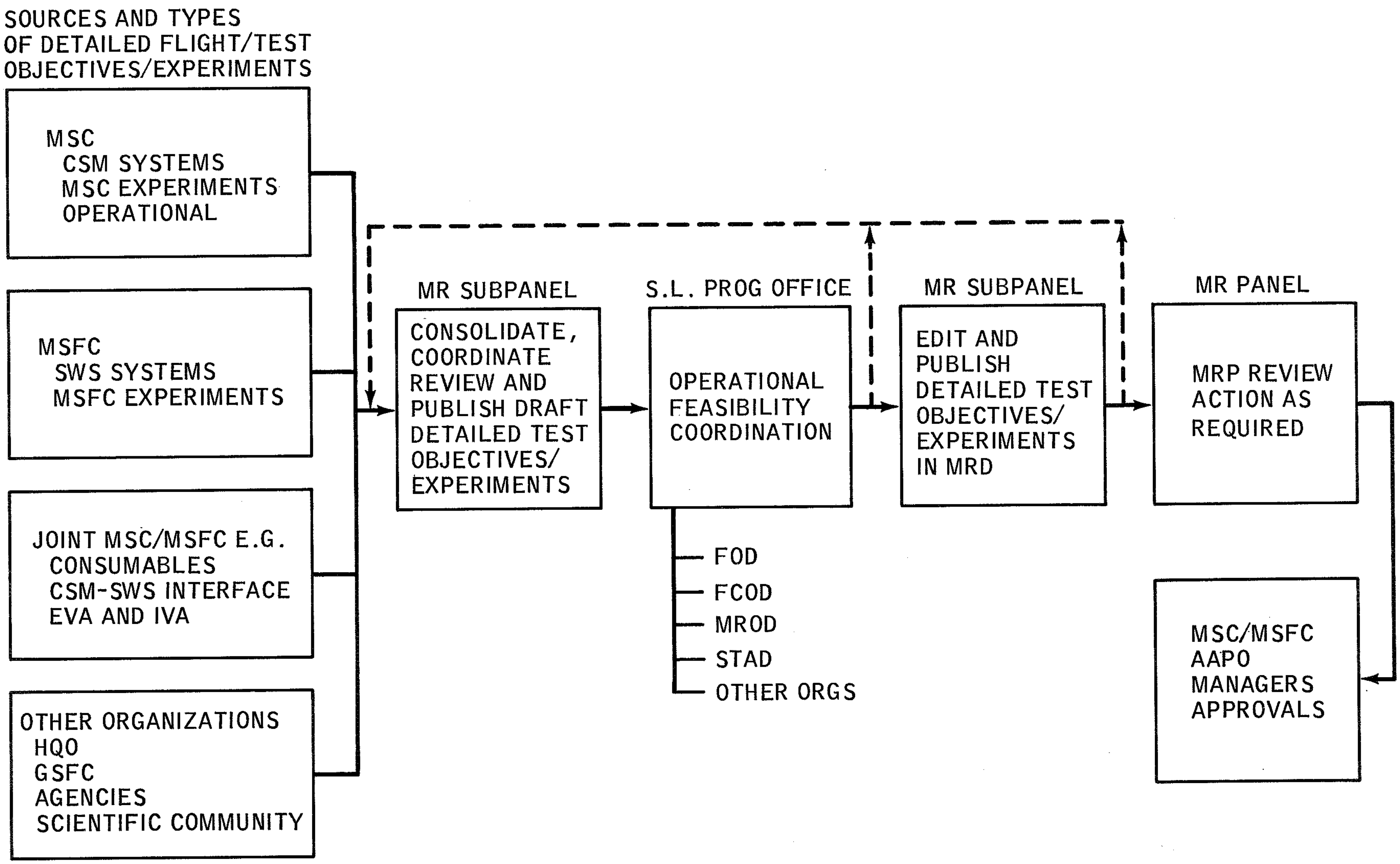


NOTE:
SOME PARALLEL ACTIVITIES NOT SHOWN ARE PRELIMINARY REWRITE OF PROPOSALS FOR DETAILED OBJECTIVES, IMPACT STUDIES ON MISSION PLANNING, OVERALL PROGRAM CAPABILITY TO SUPPORT THE PROPOSED INVESTIGATIONS ETC.

NASA-S-71-13263-V

SKYLAB TEST OBJECTIVE FLOW

MISSION REQUIREMENTS DOCUMENT



SOURCES AND TYPES OF DETAILED FLIGHT/TEST OBJECTIVES/EXPERIMENTS

MSC
  CSM SYSTEMS
  MSC EXPERIMENTS
  OPERATIONAL

MSFC
  SWS SYSTEMS
  MSFC EXPERIMENTS

JOINT MSC/MSFC E.G.
  CONSUMABLES
  CSM-SWS INTERFACE
  EVA AND IVA

OTHER ORGANIZATIONS
  HQO
  GSFC
  AGENCIES
  SCIENTIFIC COMMUNITY

MR SUBPANEL

CONSOLIDATE, COORDINATE REVIEW AND PUBLISH DRAFT DETAILED TEST OBJECTIVES/ EXPERIMENTS

S.L. PROG OFFICE

OPERATIONAL FEASIBILITY COORDINATION

- FOD
- FCOD
- MROD
- STAD
- OTHER ORGS

MR SUBPANEL

EDIT AND PUBLISH DETAILED TEST OBJECTIVES/ EXPERIMENTS IN MRD

MR PANEL

MRP REVIEW ACTION AS REQUIRED

MSC/MSFC AAPO MANAGERS APPROVALS

NASA-S-71-12835-V

SKYLAB/EREP DETAILED TEST OBJECTIVES

GENERAL

WHEN A PROPOSED INVESTIGATION OR EXPERIMENT IS APPROVED FOR FLIGHT ON SKYLAB, IT MUST BE DOCUMENTED IN THE MISSION REQUIREMENTS DOCUMENT (MRD) WHICH IS APPROVED BY BOTH THE MSC AND MSFC MANAGERS OF THE SKYLAB PROGRAM. INDIVIDUAL EXPERIMENTS ARE INCLUDED IN THE MRD IN THE FORM OF DETAILED TEST OBJECTIVES (DTO's). ALL OBJECTIVES PLANNED IN THE FLIGHT PLAN AND CONDUCTED BY THE CREW MUST BE IN THIS FORM. STUDIES, INVESTIGATIONS, OR EXPERIMENTS CONDUCTED AFTER THE SKYLAB MISSION WHICH USE EXISTING DATA AVAILABLE AND REQUIRING NO SPECIFIC MISSION SUPPORT OR PLANNING NEED NOT BE DOCUMENTED IN THIS MANNER.

SINCE MOST INVESTIGATIONS ENVISIONED FOR EREP WILL REQUIRE SPECIFIC SENSOR ACTIVATION OVER SPECIFIC TEST SITES, EREP EXPERIMENTS WILL BE REQUIRED TO BE DOCUMENTED IN THE DTO FORMAT. CONSEQUENTLY, THIS DOCUMENT WILL INSTRUCT POTENTIAL PROPOSERS ON HOW TO PROPERLY DOCUMENT THEIR REQUIREMENTS SO AS TO ENSURE PROPER MISSION PLANNING, CREW SUPPORT, AND DATA GATHERING PLANS.

DEFINITIONS

PRIOR TO DISCUSSING THE INSTRUCTIONS ON HOW TO DOCUMENT PROPERLY YOUR SKYLAB EREP REQUIREMENTS, YOU SHOULD HAVE THE BENEFIT OF THE FOLLOWING DEFINITIONS:

MISSION OBJECTIVES: MISSION OBJECTIVES ARE THE ENDS TOWARD WHICH EFFORTS ARE DIRECTED FOR EACH MISSION. MISSION OBJECTIVES ARE SPECIFIED BY THE OMSF.

EXPERIMENTS: EXPERIMENTS ARE PLANNED INVESTIGATIONS WHICH ARE CONDUCTED INFLIGHT DURING MANNED SPACE MISSIONS OR WHICH ARE ESSENTIALLY CONNECTED WITH THE INFLIGHT SITUATION. THESE INVESTIGATIONS, WHICH ARE APPROVED BY THE MANNED SPACE FLIGHT EXPERIMENTS BOARD AND ASSIGNED BY THE HEADQUARTERS PROGRAM OFFICE (ML), ARE CONDUCTED TO OBTAIN RESEARCH INFORMATION WHICH CAN CONTRIBUTE TO THE ADVANCEMENT OF SCIENCE AND TECHNOLOGY.

NASA-S-71-12836-V

SKYLAB/EREP DETAILED TEST OBJECTIVES (CONT)

DETAILED TEST OBJECTIVE: THE DTO's ARE SCIENTIFIC, ENGINEERING, OR OPERATIONAL OBJECTIVES WHICH AMPLIFY MISSION OBJECTIVES OR DETAIL A MAJOR DEVELOPMENT PURPOSE OR FEATURES OF THE MISSION. THE ACCOMPLISHMENT OF A DETAILED TEST OBJECTIVE WILL BE AN IMPORTANT CONSIDERATION IN DETERMINING THE DEGREE OF ACHIEVEMENT OF THE MISSION OBJECTIVE(S).

MANDATORY DATA: MANDATORY DATA IN A DETAILED TEST OBJECTIVE ARE DATA DEEMED ESSENTIAL FOR THE EVALUATION OF THE TEST OBJECTIVE.

HIGHLY DESIRABLE DATA: HIGHLY DESIRABLE DATA IN A DETAILED TEST OBJECTIVE ARE DATA THAT AID EVALUATION OF THE TEST OBJECTIVE. THESE DATA SUPPLY INFORMATION WHICH IS AVAILABLE FROM ALTERNATE SOURCES OR WHICH IS NOT REQUIRED FOR EVALUATION OF THE ESSENTIAL PARTS OF THE OBJECTIVE.

DETAILED TEST OBJECTIVES

THE FOLLOWING GUIDELINES SHOULD BE USED IN DOCUMENTING AN APPROVED EXPERIMENT UTILIZING THE EARTH RESOURCES EXPERIMENT PACKAGE. PROPOSED EXPERIMENTS NOT YET APPROVED SHOULD BE DOCUMENTED PER THE INSTRUCTIONS IN THE ERTS/EREP PROPOSAL INSTRUCTION HANDBOOK. THOSE INVESTIGATORS SHOULD BE AWARE, HOWEVER, THAT EVENTUALLY, APPROVED EXPERIMENTS WILL HAVE TO CONSIDER THE FOLLOWING GUIDELINES WHICH ARE INTENDED TO ENSURE THE ACQUISITION OF ALL DATA REQUIRED TO FULFILL THE OBJECTIVE.

TITLE: A VERY SHORT DESCRIPTION OF THE EXPERIMENT WHICH CAN BE USED TO LIST OR DISCUSS THE EXPERIMENT WITH A MINIMUM OF WORDS, e.g., "SEVERE STORMS," "ZERO GRAVITY FLAMMABILITY," "WHITE LIGHT CORONAGRAPH."

SKYLAB/EREP DETAILED TEST OBJECTIVES (CONT)

PURPOSE: A VERY SHORT PARAGRAPH OF ONE OR TWO SENTENCES WHICH EXPLAINS THE INTENTION OF THE EXPERIMENT IN GENERAL TERMS, e.g., "TO MEASURE ELECTROCARDIOGRAPH POTENTIALS IN ZERO g," "TO QUANTITATIVELY EVALUATE SPECIFIC REGIONS OF THE IR SPECTRA FOR APPLICATION TO EARTH RESOURCES SENSING FROM ORBITAL ALTITUDES." ANY MORE DETAIL CAN BE DESCRIBED IN THE "BACKGROUND" SECTION OF THE DTO.

FUNCTIONAL OBJECTIVES (FO's): THIS SECTION SHOULD CONTAIN EACH SEPARATE PART OF THE OVERALL OBJECTIVE. THE TOTAL OF ALL FO's CONSTITUTE THE ENTIRE DTO. IDEALLY, EACH FO IS A SCHEDULABLE ENTITY WHICH CAN SATISFY ALL OR PART OF THE OVERALL OBJECTIVE. BY "SCHEDULABLE" WE MEAN IT MUST OCCUR AT A CERTAIN TIME, AT A CERTAIN PLACE, OR ASSOCIATED WITH A SPECIFIC SET OF CONDITIONS; e.g., "FO 1, OBTAIN VISIBLE IR SPECTRA OF A SEVERE STORM." "FO 2, OBTAIN VISIBLE IR SPECTRA OF AN OIL SLICK." IT IS IMPORTANT TO BREAK DOWN THE DTO AS CLEARLY AS POSSIBLE INTO DEFINITIVE FO's BECAUSE THE REMAINING SECTIONS ARE WRITTEN TO ADDRESS SPECIFIC CONDITIONS, CRITERIA, AND DATA FOR THESE FO's.

TEST CONDITIONS: EACH OF THE "TEST CONDITIONS" SECTIONS SHOULD LIST ALL OF THE NECESSARY CONDITIONS WHICH MUST BE ARRANGED OR OCCUR TO ADEQUATELY SATISFY EACH FUNCTIONAL OBJECTIVE. THESE CONDITIONS SHOULD INCLUDE ITEMS SUCH AS THE FOLLOWING:

- SPACECRAFT
- TEST SITE
- CREWS
- GROUND TRUTH
- TIME OF YEAR OR SEASON
- CELESTIAL CONDITIONS
- TRAJECTORY
- MISSION CONTROL
- SENSOR(S)

SKYLAB/EREP DETAILED TEST OBJECTIVES (CONT)

- CLOUD COVER
- SNOW COVER
- VEHICLE ATTITUDE

BE SPECIFIC IF YOU MUST, BUT BE SURE TO INDICATE YOUR FLEXIBILITY IF, IN FACT, YOUR EXPERIMENT CAN BE SO.

SUCCESS CRITERIA: THE INFORMATION YOU PUT INTO THIS SECTION WILL BE THAT USED TO WEIGH THE OVERALL SUCCESS OF YOUR PART OF THE MISSION OBJECTIVES. IT IS IMPORTANT THAT YOU LIST ONLY THOSE EVENTS WHICH MUST TAKE PLACE IN ORDER TO SATISFY THE PURPOSE OF EACH FO. THE "SUCCESS CRITERIA" SHOULD ADDRESS THE MINIMUM CONDITIONS AND DATA NEEDED AS WELL AS PERTINENT EVALUATIONS AND CONCLUSIONS. IT IS POSSIBLE TO HAVE EVERYTHING YOU THOUGHT WAS REQUIRED BUT STILL NOT BE ABLE TO DETERMINE THE DESIRED RESULTS. IF ONLY ONE PASS OVER A SITE IS REQUIRED TO SATISFY THE FO BUT FIVE WERE DESIRED, INDICATE THIS IN YOUR REQUIREMENT. CARE SHOULD BE TAKEN NOT TO WRITE SUCCESS CRITERIA WHICH YOU KNOW OR SUSPECT CAN NEVER BE MET.

DATA REQUIREMENTS: THIS IS POSSIBLY THE MOST IMPORTANT PORTION OF THE DTO IN THAT THE MSC SUPPORTING ORGANIZATIONS MUST REVIEW AND EVALUATE EACH DTO TO SEE HOW THEY WILL SUPPORT YOUR REQUIREMENTS. IT IS THIS SECTION WHICH WILL INDICATE LONG LEADTIME ITEMS SUCH AS SPECIAL PROCESSING EQUIPMENT OR TECHNIQUES WHICH MUST BE DEVELOPED OR SPECIAL PROCEDURES WHICH MUST BE ESTABLISHED. THIS SECTION SHOULD OUTLINE TYPE AND QUANTITY OF DATA NEEDED TO SATISFY THE OBJECTIVES AND ANY SPECIAL PROCESSING OR HANDLING TECHNIQUES WHICH NEED TO BE IDENTIFIED. YOU SHOULD CONSIDER THE FOLLOWING:

- PHOTO REQUIREMENTS
- MAGNETIC TAPE
- ASTRONAUT VOICE TAPES AND LOGS
- TRAJECTORY SUPPORT DATA
- VEHICLE PARAMETERS

NASA-S-71-12834-V

SKYLAB/EREP DETAILED TEST OBJECTIVES (CONT)

- GROUND TRUTH DATA
- AIRCRAFT DATA
- SPECIAL HANDLING REQUIREMENTS
- SPECIAL PROCESSING REQUIREMENTS

BACKGROUND

IT IS IN THIS SECTION THAT YOU SHOULD INCLUDE ALL THE DETAILS WHICH SUPPORT YOUR EXPERIMENT EXPLAINING ITS SCIENTIFIC WORTH, HOW IT MIGHT FIT IN WITH OTHER INVESTIGATIONS, AND IN GENERAL, EXPLAIN TO THE READER, THE LOGIC AND RATIONALE WHICH HAS GONE INTO THE DEVELOPMENT OF THIS OBJECTIVE. ELABORATION OF MATHEMATICAL EQUATIONS ARE DISCOURAGED BUT SHOW ENOUGH INFORMATION TO JUSTIFY YOUR EXPERIMENT.

NASA-S-71-12808-V

DETAILED TEST OBJECTIVE EXAMPLE

EXPERIMENT SO63 UV AIRGLOW HORIZON PHOTOGRAPHY

PURPOSE

THE PURPOSE IS TO PHOTOGRAPH THE EARTH OZONE LAYER AND THE TWILIGHT AIRGLOW IN VISIBLE AND ULTRAVIOLET (UV) LIGHT. THESE PHOTOS, MADE ON A GLOBAL SCALE, WILL BE VALUABLE IN THE STUDIES OF VISIBLE AND UV MECHANISMS, AND KNOWLEDGE MAY ALSO BE GAINED PERTAINING TO UPPER ATMOSPHERIC MOVEMENTS WHICH SEEM TO BE ASSOCIATED WITH AIRGLOW VARIATIONS.

THE FUNCTIONAL OBJECTIVES ARE AS FOLLOWS:

FO 1)	PHOTOGRAPH THE EARTH'S OZONE ATMOSPHERE AT UV WAVELENGTHS AND PHOTOGRAPH THE EARTH AND ITS ATMOSPHERE AT VISIBLE WAVELENGTHS	(40%)*
FO 2)	PHOTOGRAPH THE EARTH'S TWILIGHT AIRGLOW AT UV WAVELENGTHS	(30%)*
FO 3)	PHOTOGRAPH THE EARTH'S TWILIGHT AIRGLOW AT VISIBLE WAVELENGTHS	(30%)*

*WEIGHTING FACTORS BASED ON 100%

NASA-S-71-12809-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

TEST CONDITIONS

FO 1) EXPERIMENT ASSEMBLY I CONSISTING IN PART OF TWO CAMERAS, ONE FOR TAKING UV PHOTOGRAPHS AND THE OTHER FOR TAKING REGULAR COLOR PHOTOGRAPHS, WILL BE USED. THE UV CAMERA WILL BE MOUNTED AT THE ANTI-SOLAR SCIENTIFIC AIR-LOCK (SAL). THE COLOR CAMERA WILL BE MOUNTED IN THE WARDROOM WINDOW OF THE ORBITAL WORKSHOP (OWS).

TEN DAYLIGHT Z-LV(E) PASSES WILL BE REQUIRED. THESE PASSES MAY BE THE SAME AS EARTH RESOURCES EXPERIMENTS PACKAGE (EREP) Z-LV(E) PASSES IF THE CREW IS AVAILABLE.

TRACKING WILL BE ACCOMPLISHED BY AN ASTRONAUT WHO WILL KEEP THE OPTICAL SIGHT ON THE UV CAMERA POINTED AT SOME FEATURE ON OR NEAR THE EARTH'S SURFACE PER PROCEDURES CONTAINED IN THE S063 EXPERIMENT OPERATIONS HANDBOOK (EOH).

THE OPTICAL SIGHTING DEVICE WILL BE KEPT POINTED TO WITHIN TBD DEGREE ON A CHOSEN TRACKING FEATURE

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

IMAGE MOTION CONTROL (IMC) WILL BE MAINTAINED BY THE EXPERIMENTER THROUGH THE DURATION OF THE EXPOSURE. REQUIRED TRACKING RATES ARE FUNCTIONS OF ORBITAL POSITION AND TARGET ALTITUDE. APPROXIMATE AVERAGE RATES ARE 1 DEGREE/SEC FOR THE OZONE PHOTOGRAPHY.

THE EARTH'S OZONE LAYER WILL BE PHOTOGRAPHED FROM AS MANY ORBITAL POSITIONS AS POSSIBLE DURING DAYTIME.

IT IS ESTIMATED THAT 15 EXPOSURES PER ORBIT CAN BE MADE. APPROXIMATELY 10 ORBITS WILL BE REQUIRED TO COMPLETE THE 150 EXPOSURE MISSION.

DURATIONS OF EXPOSURES WILL BE VARIED AS FILTERS AND TARGET BRIGHTNESS REQUIRE.

THE DURATION OF A PERFORMANCE OF AN OZONE PHOTOGRAPHY SESSION IS ESTIMATED TO BE 30 MINUTES. THE AVERAGE TOTAL TIME FOR TAKING EACH OF THE 15 EXPOSURES IS ESTIMATED TO BE TWO MINUTES. THIS INCLUDES ALL OPERATIONS SUCH AS DATA ANNOTATION, FILM ADVANCES, FILTER CHANGE, TARGET SELECTION AND ACQUISITION, CAMERA ADJUSTMENT, ETC.

NASA-S-71-12811-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

FO 2) EXPERIMENT ASSEMBLY II CONSISTING IN PART OF A UV CAMERA WILL BE ATTACHED TO THE SOLAR SAL.

APPROXIMATELY 14 ORBITS WILL BE REQUIRED TO PERFORM THIS PORTION OF THE TWILIGHT AIRGLOW PHOTOGRAPHY. A DIFFERENT SET OF FILTERS WILL BE INSTALLED AT THE END OF THE SEVENTH ORBIT.

FO 3) EXPERIMENT ASSEMBLY II CONSISTING IN PART OF A VISIBLE LIGHT CAMERA WILL BE ATTACHED TO THE SOLAR SAL.

APPROXIMATELY 14 ORBITS WILL BE REQUIRED TO PERFORM THIS PORTION OF THE TWILIGHT AIRGLOW PHOTOGRAPHY. A DIFFERENT SET OF FILTERS WILL BE INSTALLED AT THE END OF THE SEVENTH ORBIT.

FO 2) THE AIRGLOW, TOGETHER WITH THE EARTH LIMB AND BACKGROUND
FO 3) STAR FIELD, WILL BE PHOTOGRAPHED FROM THE SPACECRAFT NIGHT POSITION IN THE SOLAR DIRECTION.

THE INTERNAL LIGHTS THAT MAY CAUSE LIGHT TO ENTER THE CAMERA WILL BE EXTINGUISHED DURING EXPOSURE PERIODS. ALL EXTERNAL LIGHTS WILL BE TURNED OFF DURING FILM EXPOSURE.

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

THE CAMERA WILL BE KEPT POINTED AT A CHOSEN AIRGLOW LAYER WITHIN TBD DEGREE

IMAGE MOTION CONTROL (IMC) WILL BE MAINTAINED BY THE EXPERIMENTER THROUGH THE DURATION OF EXPOSURE. REQUIRED TRACKING RATES ARE FUNCTIONS OF ORBITAL POSITION AND TARGET ALTITUDE. APPROXIMATE AVERAGE RATES ARE 0.06 DEGREES/SEC.

SIX TO FIFTEEN EXPOSURES WILL BE MADE PER ORBIT FOR APPROXIMATELY 28 ORBITS BEGINNING WHEN THE SPACECRAFT IS LOCATED ON THE DARK SIDE OF THE EARTH BETWEEN SOLAR DEPRESSION ANGLES OF -26.5 DEGREES AND -37.5 DEGREES FOR ALL β ANGLES BETWEEN ±52.5 DEGREES.

THE DURATION OF A PERFORMANCE WILL BE FROM 10 TO 30 MINUTES DEPENDING UPON THE AVAILABLE TIME SUITABLE FOR OBSERVING IN A GIVEN ORBIT. THE AVAILABLE TIME IS A FUNCTION OF THE β ANGLE. AS MANY PHOTOGRAPHIC SESSIONS ARE TO BE SCHEDULED AT A β ANGLE EQUAL TO OR NEAR ±52.5 DEGREES AS POSSIBLE.

TWO SPECIAL HORIZON PHOTOGRAPHY SESSIONS WILL BE REQUIRED WHEN THE SPACECRAFT IS BETWEEN SOLAR DEPRESSION ANGLES OF -26.5 DEGREES AND -37.5 DEGREES AND (1) THE SPACECRAFT GEOMAGNETIC LATITUDE IS NEAR NORTH AND/OR SOUTH AURORAL ZONE, (2) SPACECRAFT GEOMAGNETIC LATITUDE IS NEAR THE EQUATOR ±10 DEGREES.

NASA-S-71-12813-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

THE EXPERIMENTS WILL BE PERFORMED WHEN THE CLUSTER IS IN THE X-IOP/Z ORIENTATION INCLUDING PERIODS OF CONTROL MOMENT GYRO (CMG) DESATURATION.

FO 1) DETAILED PHOTOGRAPHIC OPERATIONS WILL BE CONDUCTED
FO 2) IN ACCORDANCE WITH PROCEDURES CONTAINED IN THE S063
FO 3) EOH.

THE SPACECRAFT ORIENTATION WILL BE KNOWN TO WITHIN ±1 DEGREE

THE MAXIMUM PITCH, YAW OR ROLL RATES DURING THE EXPOSURE PERIOD WILL NOT EXCEED 0.1 DEGREE/SEC.

NO WASTE DISPOSAL OR THRUSTER ATTITUDE CONTROL SUBSYSTEM (TACS) OPERATION WILL BE PERMITTED DURING EXPERIMENT PERFORMANCE.

THE THERMAL SENSITIVITY OF THE CAMERAS AND FILM REQUIRES THAT THE ENVIRONMENTAL TEMPERATURES WILL BE MAINTAINED AS FOLLOWS:

ITEM	STORED AND/OR TRANSPORTED	OPERATE
EXPERIMENT ASSEMBLY	0-100 F	65-90 F
FILM MAGAZINE	85 F MAX	65-90 F

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

THE FILM MAGAZINES WILL REQUIRE PROTECTION FROM RADIATION DURING REENTRY BY STOWAGE IN THE COMMAND MODULE (CM). DURING LAUNCH AND THE MANNED PHASE THE MAGAZINES WILL BE STOWED IN THE RADIATION SHIELDED ORBITAL WORKSHOP (OWS) FILM VAULT. IF EXPERIMENT OPERATION TIMES ARE SEPARATED BY MORE THAN FOUR HOURS, THE FILM WILL BE STOWED IN THE OWS FILM VAULT.

VOICE TAPES OF ASTRONAUT ANNOTATIONS DURING EXPERIMENT OPERATION ARE TO BE DUMPED AFTER EACH SESSION.

THE EXPERIMENT SCHEDULE WILL BE UPDATED BY COMPUTER AFTER ESTABLISHMENT OF THE CLUSTER ORBIT, AND AT INTERVALS PRIOR TO OBSERVING TIMES. THIS UPDATED SCHEDULE WILL BE FURNISHED THE EXPERIMENTER ONE DAY PRIOR TO SCHEDULED OBSERVING SESSION. THE EXPERIMENTER WILL THEN UPDATE PHOTOGRAPHY SCHEDULES AS REQUIRED. THE UPDATED INFORMATION WILL THEN BE RELAYED TO THE CREW.

SUCCESS CRITERIA

FO 1) TBD COLOR AND UV PHOTOGRAPHY OF THE EARTH'S OZONE LAYER FOR TBD ORBITS SHALL BE OBTAINED AND RETURNED TO EARTH. THE QUALITY OF THESE PHOTOGRAPHS SHALL BE ACCEPTABLE TO THE PRINCIPAL INVESTIGATOR.

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

FO 2) TBD UV PHOTOGRAPHS OF THE EARTH'S TWILIGHT AIRGLOW FOR TBD ORBITS SHALL BE OBTAINED AND RETURNED TO EARTH. THE QUALITY OF THESE PHOTOGRAPHS SHALL BE ACCEPTABLE TO THE PRINCIPAL INVESTIGATOR.

FO 3) TBD BLACK AND WHITE (B&W) PHOTOGRAPHS OF THE EARTH'S TWILIGHT AIRGLOW FOR TBD ORBITS SHALL BE OBTAINED AND RETURNED TO EARTH. THE QUALITY OF THESE PHOTOGRAPHS SHALL BE ACCEPTABLE TO THE PRINCIPAL INVESTIGATOR.

EVALUATION

FO 1)
FO 2)
FO 3)

THE EXPOSED FILM MAGAZINES WILL BE FORWARDED TO MANNED SPACECRAFT CENTER (MSC) FOR PROCESSING. FINAL PROCESSING OF FLIGHT DATA WILL BE MADE BY THE EXPERIMENTERS AFTER RECEIPT OF PROCESSED FLIGHT FILM, COMPUTER-COMPATIBLE TAPE, EPHEMERIS DATA, ASTRONAUT RECORDS AND OTHER DATA. RESULTS OF THE DATA ANALYSIS AND EVALUATION WILL BE REPORTED BY THE PRINCIPAL INVESTIGATOR IN A SERIES OF REPORTS, WITH AN INITIAL DRAFT OF THE FINAL REPORT TO BE AVAILABLE WITHIN TBD MONTHS FOLLOWING RECEIPT OF THE ABOVE MENTIONED DATA. (TELEMETRY DATA, ASTRONAUT RECORDS, PHOTOGRAPHS, TRAJECTORY DATA, OTHER DATA)

NASA-S-71-12816-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

DATA REQUIREMENTS

1) ASTRONAUT LOGS OR VOICE RECORDS: (M)

   a) EXPERIMENT LOG BOOK ENTRIES AT THE BEGINNING AND END OF EACH EXPERIMENT, BEGINNING FILM EXPOSURE NUMBER, LAST EXPOSURE NUMBER, AND CONDITION OF EQUIPMENT AT END OF LAST SESSION

   b) VOICE ANNOTATIONS OF THE ASTRONAUT FOR EACH OBSERVING SESSION INCLUDING CAMERA IDENTIFICATION, FILTER CODE, EXPOSURE NUMBER, ANGLE OF VIEW ±1 ACCURACY WITH RESPECT TO NORMAL TO WINDOW AT BEGGING OF EXPOSURE, EXPOSURE INITIATION TIME IN (IN GREENWICH MEAN TIME GMT ±1.0 SEC), AND EXPOSURE DURATION

   c) PRIOR TO EACH PHOTOGRAPHY SESSION A VOICE RECORDING OF BEGINNING EXPOSURE NUMBER, FILTER IDENTIFICATION, INITIAL CAMERA BRACKET SETTING, GMT AND IDENTIFICATION OF ANY TARGETS OF OPPORTUNITY

2) PHOTOGRAPHS: (M)

   FILM MAGAZINES CONTAINING THE EXPOSED UV, COLOR AND B&W FILM.

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

3) TRAJECTORY DATA: (M)

CAMERA POINTING REQUIREMENTS FOR BOTH OZONE AND AIRGLOW HORIZON PHOTOGRAPHY WILL BE A FUNCTION OF ACTUAL CLUSTER PARAMETERS, SOLAR ORIENTATION AND SPACECRAFT LOCATION IN ORBIT. A COMPUTER PROGRAM FOR COMPUTATION AND PRINTOUT OF A PREDICTED SCHEDULE BASED ON THE PARAMETER LISTED BELOW WILL BE REQUIRED. THIS SCHEDULE WILL BE REQUIRED TWO MONTHS PRIOR TO LAUNCH, AFTER ESTABLISHMENT OF CLUSTER ORBIT AND AT INTERVALS ONE DAY PRIOR TO OBSERVING TIMES.

DATA REQUIRED FOR COMPUTATION OF PHOTOGRAPHY SESSIONS WILL BE AS FOLLOWS:

a) SOLAR BETA (β) ANGLE VERSUS GMT WITH ACCURACY TO ±0.1 DEGREE

b) TIME OF OCCURENCE (±1 SEC GMT) OF SPACECRAFT SUNRISE, NOON, SUNSET, MIDNIGHT, PASSAGE OVER THE EARTH'S TERMINATOR AND EARTH'S GEOGRAPHIC AND GEOMAGNETIC EQUATOR

c) PREDICTED ORBITS AND DATES (GMT) WHEN SOLAR BETA ANGLE WILL BE ±52.5 DEGREES OR WHEN THE BETA ANGLE WILL BE A MAXIMUM (PLUS OR MINUS), IF A ±52.5 DEGREE BETA ANGLE WILL NOT BE ATTAINED DURING THE MISSION

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

d) PREDICTED SOLAR ELEVATION AND DEPRESSION ANGLES IN GEOCENTRIC DEGREES (±0.1 DEGREE) VERSUS GMT

e) PREDICTED ORBITAL VELOCITY IN GEOCENTRIC DEGREES PER SECOND (±0.1 DEGREE PER SECOND)

f) FOR AIRGLOW PHOTOGRAPHY, PREDICTED GMT AT 10 SECOND INTERVALS VERSUS SOLAR DEPRESSION ANGLE WHEN THE SPACECRAFT WILL BE AT SOLAR DEPRESSION ANGLES BETWEEN -26.5 DEGREES AND -37.5 DEGREES

5) OTHER DATA: (POSTFLIGHT) (M)

a) GROUND TRACK PLOTS FOR ORBITS DURING WHICH THE EXPERIMENTS WERE OPERATED SUCH AS STANDARD PLOTS OF ORBITS PRINTED ON A WORLD MAP INCLUDING TIMES OF EXPERIMENT OPERATION.

b) A COMPUTER-COMPATIBLE DIGITAL TAPE CONTAINING EXPERIMENT DATA MERGED WITH SUPPORT DATA TO INCLUDE THE FOLLOWING:

(1) SPACECRAFT LATITUDE, LONGITUDE, AND ALTITUDE AT TIME OF EXPOSURE INITIATION

NASA-S-71-12819-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

(2) SOLAR BETA ANGLE AND SOLAR ELEVATION ANGLE (GEOCENTRIC DEGREES ±0.1 DEGREE AT TIME OF EXPOSURE INITIATION

(3) ORBITAL VELOCITY IN GEOCENTRIC DEGREES/SEC (±0.1 DEG/SEC)

c) A COPY OF EPHEMERIS DATA

BACKGROUND

OZONE (O_3) EXISTS IN THE TERRESTRIAL ATMOSPHERE IN A BROAD LAYER BETWEEN 15 KM AND 50 KM WITH A CONCENTRATION MAXIMUM IN THE VICINITY OF 25 KM. THE TOTAL AMOUNT OF O_3 IN A VERTICAL COLUMN IS EQUIVALENT TO A COLUMN ABOUT 2.0 CM HIGH AT NTP BUT IT VARIES CONSIDERABLY WITH GEOGRAPHIC LOCATION, THE SEASONS, AND DIURNALLY. BY MAPPING THE DISTRIBUTION OF OZONE THIS EXPERIMENT WILL PROVIDE A NEW APPROACH FOR SOLVING SOME OF THE MANY PROBLEMS CONNECTED WITH UNDERSTANDING THE OZONOSPHERE, SUCH AS THE CIRCULATION OF THE OZONE, ITS CONNECTION WITH THE MORPHOLOGY OF WEATHER PATTERNS, AND ITS ROLE IN THE PRODUCTION OF HYDROXYL (OH) EMISSION IN THE AIRGLOW.

NASA-S-71-12820-V

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

THE LIGHT EMITTED FROM THE EARTH'S UPPER ATMOSPHERE KNOWN AS THE TWILIGHT AIRGLOW, IS DEFINED TO IRIGINATE FROM THAT REGION IN THE UPPER ATMOSPHERE WHERE THE SOLAR RADIATION EXCITING IT ENTERS THE EMITTING LAYER FROM UNDERNEATH.

THE AIRGLOW EMITTED AT WAVELENGTH 3914 A BY IONIZED MOLECULAR NITROGEN IS OF PARTICULAR INTEREST AT TWILIGHT. IT ORIGINATES IN A LAYER ABOUT 20 KM THICK AT AN ALTITUDE OF APPROXIMATELY 120 KM. CHARACTERISTICS OF THIS TWILIGHT RADIATION ARE DIFFICULT TO MEASURE FROM THE GROUND: THEREFORE, INFORMATION ABOUT THE INTENSITY DISTRIBUTION VERSUS TIME AND ALTITUDE IS MEAGER AND THE MECHANISMS FOR PRODUCTION OF THE EMISSION ARE IMPERFECTLY UNDERSTOOD. RESULTS OF THIS EXPERIMENT APPLIED TO THESE PROBLEMS WILL BE VALUABLE.

IT WILL ALSO BE INTERESTING TO PHOTOGRAPH AT TWILIGHT THE TRANSITION FROM NIGHTTIME TO DAYTIME CONDITIONS (AND VICE VERSA) OF THE EMISSIONS OF MOLECULAR OXYGEN IN THE HERZBERG BANDS FROM ABOUT 2400 A TO 3600 A. ANY CHANGES IN ALTITUDE AND INTENSITY OF THESE BANDS WITH TIME AND LOCATION WILL BE HELPFUL TO THE STUDY OF MOLECULAR OXYGEN DISTRIBUTION IN THE ATMOSPHERE.

TWILIGHT AIRGLOW EMISSION OF ATOMIC OXYGEN (OI) AT 6300 A IS OF GREAT INTEREST BECAUSE OF THE INTIMATE RELATIONSHIP OF PRODUCTION MECHANISMS WITH IONOSPHERIC PROCESSES. THIS RADIATION IS RELATIVELY BRIGHT IN THE DAYTIME AND DECREASES IN

DETAILED TEST OBJECTIVE EXAMPLE (CONT)

INTENSITY THROUGHOUT TWILIGHT AND INTO THE NIGHT. DURING THE DAY THIS OI EMISSION IS CONCENTRATED IN A BAND PEAKED AT ABOUT 200 KM. AS DAY PROGRESSES INTO TWILIGHT AND ON INTO NIGHT, THE REGION OF EMISSION BROADENS AND THE CONCENTRATION MAXIMUM REACHES 250-300 KM.

ANOTHER OI EMISSION AT 5577 A (GREEN) ALWAYS ACCOMPANIES THE 6300 A (RED) AIRGLOW IN THE F REGION OF THE IONOSPHERE AND IN THE INTENSITY RATIO OF ABOUT ONE GREEN TO THREE RED. THE NIGHT AND DAYTIME CHARACTERISTICS OF THIS RADIATION HAVE BEEN INVESTIGATED AT LENGTH BUT LITTLE IS KNOWN ABOUT ITS TWILIGHT BEHAVIOR. OBSERVATION OF THE GREEN AND RED EMISSIONS OF OI TOGETHER WILL GREATLY INCREASE THE VALUE OF THE INDIVIDUAL OBSERVATION OF EACH.

ALTITUDES AND INTENSITIES DERIVED FROM PHOTOGRAPHS MADE DURING THE PERFORMANCE OF THE EXPERIMENT WILL PROVIDE INFORMATION ON THE GLOBAL BEHAVIOR OF THESE AIRGLOW EMISSIONS. PHOTOGRAPHS MIGHT ALSO RECORD THE ALTITUDE STRUCTURE OF THE VERY INTERESTING RED ARCS AT 6300 A WHICH ARE KNOWN TO EXIST NEAR THE EARTH'S EQUATORIAL ZONE, SOME BEING SO BRIGHT AS TO HAVE BEEN OBSERVED VISUALLY FROM THE GROUND DURING THE DAYTIME. AT THE ORBITAL INCLINATION OF 50 DEGREES, IT MIGHT ALSO BE POSSIBLE TO PHOTOGRAPH A DAYTIME OR TWILIGHT AURORA AT 3914 A OR AT 6300 A AND 5577 A.

Page intentionally left blank

NASA-S-71-12697-V

REQUIREMENTS IMPLEMENTATION

Page intentionally left blank

NASA-S-71-12763-V

REQUIREMENTS IMPLEMENTATION

SCIENCE REQUIREMENTS, DEPENDING ON THE REQUIREMENT, ARE IMPLEMENTED BY MANY ORGANIZATIONS AT MSC. REQUIREMENTS FOR ADDITIONAL HARDWARE OR EXPENDITURE OF FUNDS MUST BE APPROVED BY THE MANAGER OF THE SKYLAB PROGRAM AND THESE TYPES OF REQUIREMENTS USUALLY GO THROUGH SEVERAL MANAGEMENT BOARDS FOR REVIEW AND EVALUATION.

SCIENCE REQUIREMENTS PERTAINING TO MISSION PLANNING, OPERATIONS, DATA HANDLING, GROUND SUPPORT, AND THE LIKE ARE HANDLED IN A DIFFERENT MANNER. THE SCIENCE MISSIONS SUPPORT DIVISION OF S&AD WILL EVALUATE AND COORDINATE THIS TYPE OF REQUIREMENT WITH THE APPROPRIATE MSC ORGANIZATION SUCH AS THE FLIGHT CONTROL DIVISION, MISSION PLANNING AND ANALYSIS DIVISION, FLIGHT SUPPORT DIVISION, FLIGHT CREW SUPPORT DIVISION, ET CETERA. THESE VARIOUS ORGANIZATIONS HAVE SPECIFIC RESPONSIBILITIES FOR IMPLEMENTING CERTAIN PORTIONS OF THE OVERALL SCIENCE REQUIREMENTS.

A SPECIAL PANEL HAS BEEN ESTABLISHED TO REVIEW EREP REQUIREMENTS WITHIN THE SCIENCE AND APPLICATIONS DIRECTORATE AND AIR THESE WITH THE VARIOUS IMPLEMENTING ORGANIZATIONS MENTIONED ABOVE. THIS PANEL IS CALLED THE S&AD EREP REQUIREMENTS PANEL AND IS CHAIRED BY MANFRED VON EHRENFRIED, CHIEF, SCIENCE REQUIREMENTS AND OPERATIONS BRANCH, EXTENSION 5851.

ANOTHER SPECIAL PANEL HAS BEEN ESTABLISHED BY THE FLIGHT CONTROL DIVISION TO VERIFY ADEQUATE FLIGHT CONTROL UNDERSTANDING OF EXPERIMENT OPERATION AND TO ENSURE PROPER SUPPORT OF THE DATA REQUIREMENTS. THIS GROUP IS CALLED THE EXPERIMENT OPERATIONS PANEL AND IS CHAIRED BY JAMES SAULTZ, CHIEF, EXPERIMENT SYSTEMS BRANCH, EXTENSION 4746.

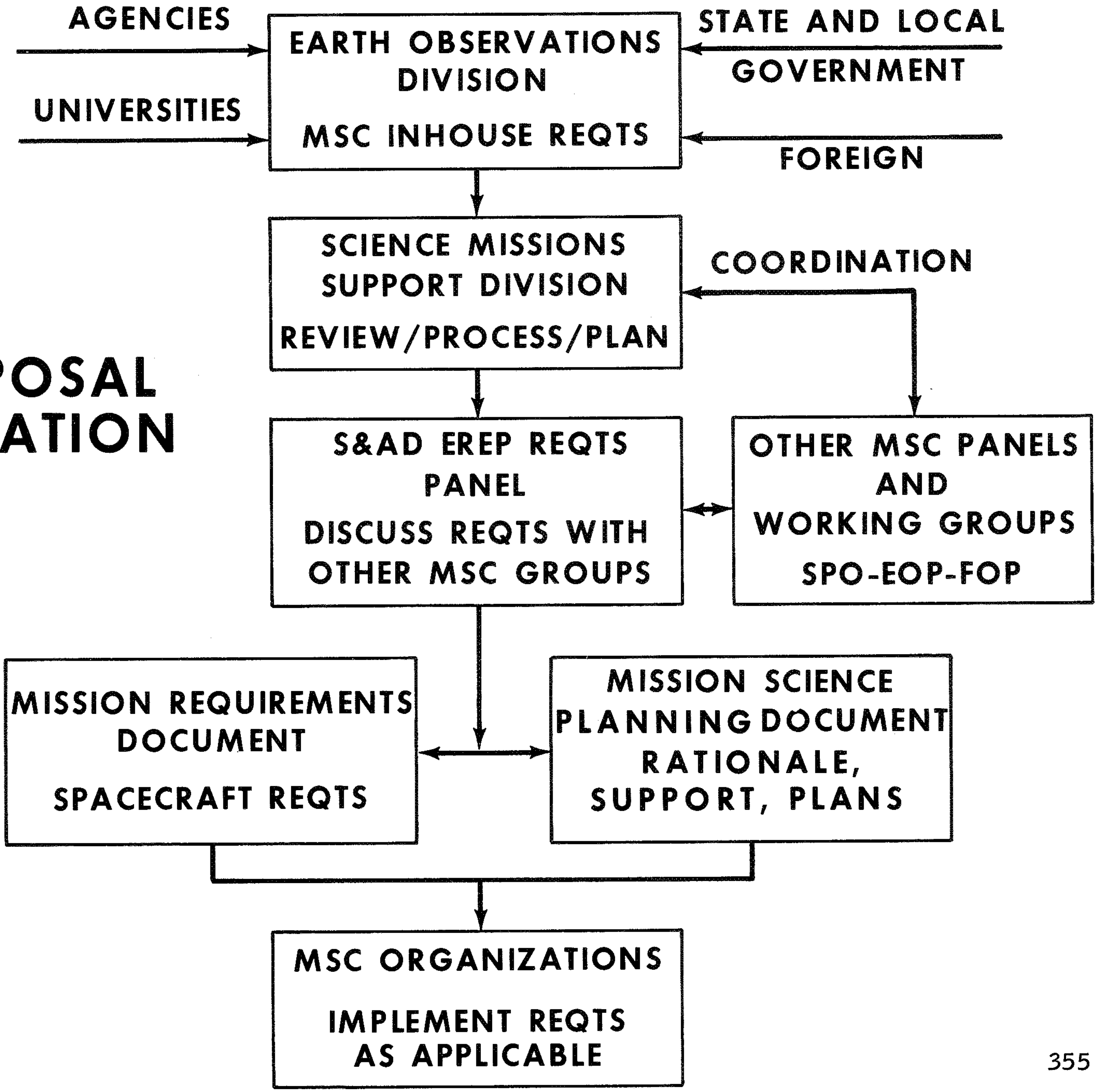
NASA-S-71-12764-V

REQUIREMENTS IMPLEMENTATION (CONT)

ALL SCIENTISTS WITH EREP INVESTIGATIONS ARE URGED TO CONTACT THE SCIENCE MISSIONS SUPPORT DIVISION AS SOON AS THEIR PROPOSAL/INVESTIGATION IS APPROVED IN ORDER THAT THE IMPLEMENTATION OF THEIR REQUIREMENTS CAN BE HANDLED MOST EFFECTIVELY.

NASA-S-71-13335-S

EREP PROPOSAL IMPLEMENTATION



AGENCIES

UNIVERSITIES

STATE AND LOCAL GOVERNMENT

FOREIGN

EARTH OBSERVATIONS DIVISION
MSC INHOUSE REQTS

SCIENCE MISSIONS SUPPORT DIVISION
REVIEW/PROCESS/PLAN

COORDINATION

S&AD EREP REQTS PANEL
DISCUSS REQTS WITH OTHER MSC GROUPS

OTHER MSC PANELS AND WORKING GROUPS
SPO-EOP-FOP

MISSION REQUIREMENTS DOCUMENT
SPACECRAFT REQTS

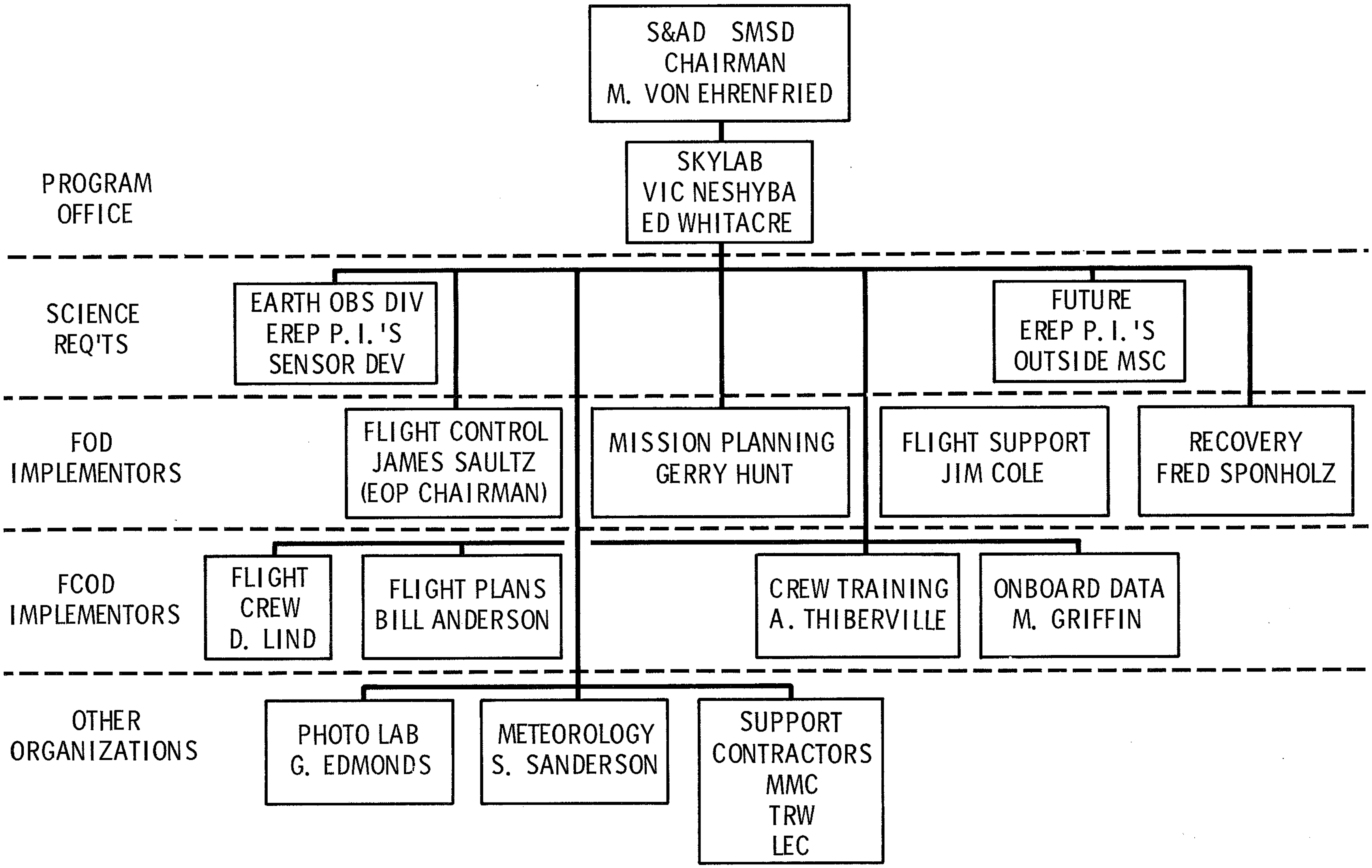
MISSION SCIENCE PLANNING DOCUMENT
RATIONALE, SUPPORT, PLANS

MSC ORGANIZATIONS
IMPLEMENT REQTS AS APPLICABLE

NASA-S-71-12734-V

S&AD EREP REQUIREMENTS PANEL

SUPPORTING PERSONNEL



S&AD SMSD
CHAIRMAN
M. VON EHRENFRIED

PROGRAM OFFICE

SKYLAB
VIC NESHYBA
ED WHITACRE

SCIENCE REQ'TS

EARTH OBS DIV
EREP P.I.'S
SENSOR DEV

FUTURE
EREP P.I.'S
OUTSIDE MSC

FOD IMPLEMENTORS

FLIGHT CONTROL
JAMES SAULTZ
(EOP CHAIRMAN)

MISSION PLANNING
GERRY HUNT

FLIGHT SUPPORT
JIM COLE

RECOVERY
FRED SPONHOLZ

FCOD IMPLEMENTORS

FLIGHT CREW
D. LIND

FLIGHT PLANS
BILL ANDERSON

CREW TRAINING
A. THIBERVILLE

ONBOARD DATA
M. GRIFFIN

OTHER ORGANIZATIONS

PHOTO LAB
G. EDMONDS

METEOROLOGY
S. SANDERSON

SUPPORT CONTRACTORS
MMC
TRW
LEC

NASA-S-71-13164-V

MSC EREP ORGANIZATION
AND
KEY PERSONNEL

Page intentionally left blank

MSC EREP PERSONNEL/ORGANIZATIONS

DIRECTOR, S&AD,	A J CALIO	713/HU3-2251

EARTH OBSERVATIONS DIVISION

CHIEF,	M R HOLTER	713/HU3-4776
STAFF SCIENTIST,	D E EVANS	713/HU3-4776
APPLICATIONS OFFICE,	R B ERB	713/HU3-4623
SKYLAB SUPPORT,	J H SASSER/~~N G FOSTER~~	713/HU3-4776
AIRCRAFT PROGRAM,	A L WATKINS	713/HU3-3853
APPLIED PHYSICS BRANCH,	A F POTTER	713/HU3-2071
DATA APPLICATIONS BRANCH,	S WHITLEY	713/HU3-4761
MAPPING SCIENCE BRANCH,	A W PATTESON	713/HU3-6287

SKYLAB PROJECT SCIENTISTS

S190	K J DEMEL	713/HU3-2071
S191	T L BARNETT	713/HU3-3242
S192	L C KORB	713/HU3-3242
S193	D E EVANS	713/HU3-4776
S194	D E EVANS	713/HU3-4776

PLANETARY AND EARTH SCIENCES DIVISION

DR. PAUL GAST	713/HU3-4464

NASA-S-71-13166-V

SCIENCE MISSIONS SUPPORT DIVISION

CHIEF,	J ZARCARO	713/HU3-4017
SKYLAB SCIENCE MISSION MANAGER,	J KALTENBACK	713/HU3-4017
EXPERIMENT DEVELOPMENT AND INTEGRATION BRANCH,	R MOKE	713/HU3-2666
SCIENCE REQUIREMENTS AND OPERATIONS BRANCH,	M von EHRENFRIED	713/HU3-5851

SKYLAB HARDWARE DEVELOPMENT MANAGERS

S190	A L GRANFIELD	713/HU3-2666
S191	R D JUDAY	713/HU3-2666
S192	W E HENSLEY	713/HU3-2666
S193	N M HATCHER	713/HU3-2666
S194	V M DAUPHIN	713/HU3-2666

NASA-S-71-13296-V

SCIENCE REQUIREMENTS AND OPERATIONS BRANCH, TM5

THE PRIMARY RESPONSIBILITY OF THIS BRANCH IS TO DEFINE, COORDINATE, AND DOCUMENT THE MISSION REQUIREMENTS PERTAINING TO SCIENTIFIC OBJECTIVES AND EXPERIMENTS ASSIGNED TO ALL SPACE MISSIONS. AS FOLLOW THROUGH, THIS BRANCH WILL INSURE THAT THESE REQUIREMENTS ARE IMPLEMENTED BY THE VARIOUS MSC IMPLEMENTING ORGANIZATIONS, COORDINATING THE DETAILS AND MAKING THE NECESSARY TRADE-OFFS AND COMPROMISES USUALLY REQUIRED

THIS OVERALL REQUIREMENT TASK INVOLVES ALL MAJOR SPACE PROGRAMS CURRENTLY APPROVED (APOLLO AND SKYLAB) AND OTHER PROGRAMS TO BE APPROVED SUCH AS SPACE STATIONS, SHUTTLES, EARTH RESOURCES, ETC

THIS TASK ALSO INVOLVES THE MORE DETAILED VEHICLES AND EXPERIMENT PACKAGES THAT ARE A PART OF THE MAJOR PROGRAMS SUCH AS THE ALSEP, SPEP, EREP, SUB-SATELLITES, CSM SIM, ROVER, ETC

THE SCOPE OF THESE RESPONSIBILITIES INCLUDES THE S&AD INPUTS TO THE MISSION REQUIREMENTS DOCUMENT; TOTAL RESPONSIBILITY FOR THE MISSION SCIENCE PLANNING DOCUMENT INCLUDING THE VARIOUS SUB-DOCUMENTS; PROVIDING ALL INVESTIGATORS ASSIGNED TO THE VARIOUS PROGRAMS A FOCAL POINT FOR SCIENCE SUPPORT; PROVIDING THE SCIENCE INPUTS TO ALL MISSION PLANNING INCLUDING REFERENCE TRAJECTORIES AND FLIGHT PLANS; COMPILING AND DOCUMENTING DETAILED EXPERIMENT OPERATING PROCEDURES; PROVIDING OPERATIONAL SCIENCE SUPPORT TO THE FLIGHT OPERATIONS DIRECTORATE DURING THE MISSIONS; AND MANAGING THE POSTMISSION DATA DISSEMINATION AND SCIENCE REPORTING

THIS BRANCH WILL BE THE PRIMARY PLANNING AND OPERATIONS SUPPORT TO THE EARTH OBSERVATIONS DIVISION, AND THE LUNAR AND EARTH SCIENCES DIVISION, AND IN GENERAL TO THE SCIENTIFIC COMMUNITY

THIS BRANCH WILL BE THE FOCAL POINT TO THE FLIGHT CREW OPERATIONS DIRECTORATE (FCOD) FOR SCIENCE EXPERIMENT FLIGHT PLANNING INPUTS AND EXPERIMENT OPERATING PROCEDURES; BOTH NORMAL AND CONTINGENCY

NASA-S-71-13283-V

EXPERIMENT OPERATIONS SECTION

JAMES BATES 483-5851

- RESPONSIBLE FOR ALL OPERATIONAL SUPPORT FOR EXPERIMENTS FOR THE DIRECTORATE FOR ALL PROGRAMS. SPECIFIC TASKS ARE
  - PI INTERFACE FOR EXPERIMENT OPERATIONS
  - MISSION CONTROL CENTER SUPPORT OF EXPERIMENTS
  - EXPERIMENT OPERATING PROCEDURES
  - FINAL MISSION PREPARATIONS
  - CREW SUPPORT FOR EXPERIMENT PROCEDURES
  - CONTINGENCY-EXPERIMENT PROCEDURES
- THESE ACTIVITIES PRIMARILY TAKE PLACE FROM LAUNCH MINUS 6 MONTHS THROUGH RECOVERY PLUS 2 MONTHS WITH CONTINUOUS SUPPORT OF LUNAR SURFACE EXPERIMENTS AND SUB-SATELLITES

NASA-S-71-13284-V

SCIENCE REQUIREMENTS AND PLANNING SECTION

PAUL STULL 483-5851

- RESPONSIBLE FOR DEFINING, COORDINATING, DOCUMENTING, AND MANAGING THE IMPLEMENTATION OF ALL SCIENCE REQUIREMENTS FOR THE DIRECTORATE. THIS RESPONSIBILITY INCLUDES THE SCIENCE EXPERIMENTS ASSIGNED TO APOLLO AND SKYLAB. SPECIFIC TASKS ARE
  - PI INTERFACE FOR REQUIREMENTS
  - MISSION REQUIREMENTS DOCUMENT INPUTS
  - MISSION SCIENCE PLANNING DOCUMENT IN TOTAL
  - EXPERIMENT FLIGHT PLANNING AND TIMELINES
  - EXPERIMENT DATA REQUIREMENTS AND IMPLEMENTATION
  - SCIENCE REPORTING AND DOCUMENTATION
  - SKYLAB EREP AND SPEP REQUIREMENTS (PASS PLANNING)
  - CREW TRAINING SUPPORT
- THESE ACTIVITIES ARE AT A PEAK FROM LAUNCH MINUS TWO YEARS TO LAUNCH MINUS SIX MONTHS AND AGAIN INDEFINATELY FOR THE POST-MISSION DATA HANDLING AND SCIENCE REPORTING

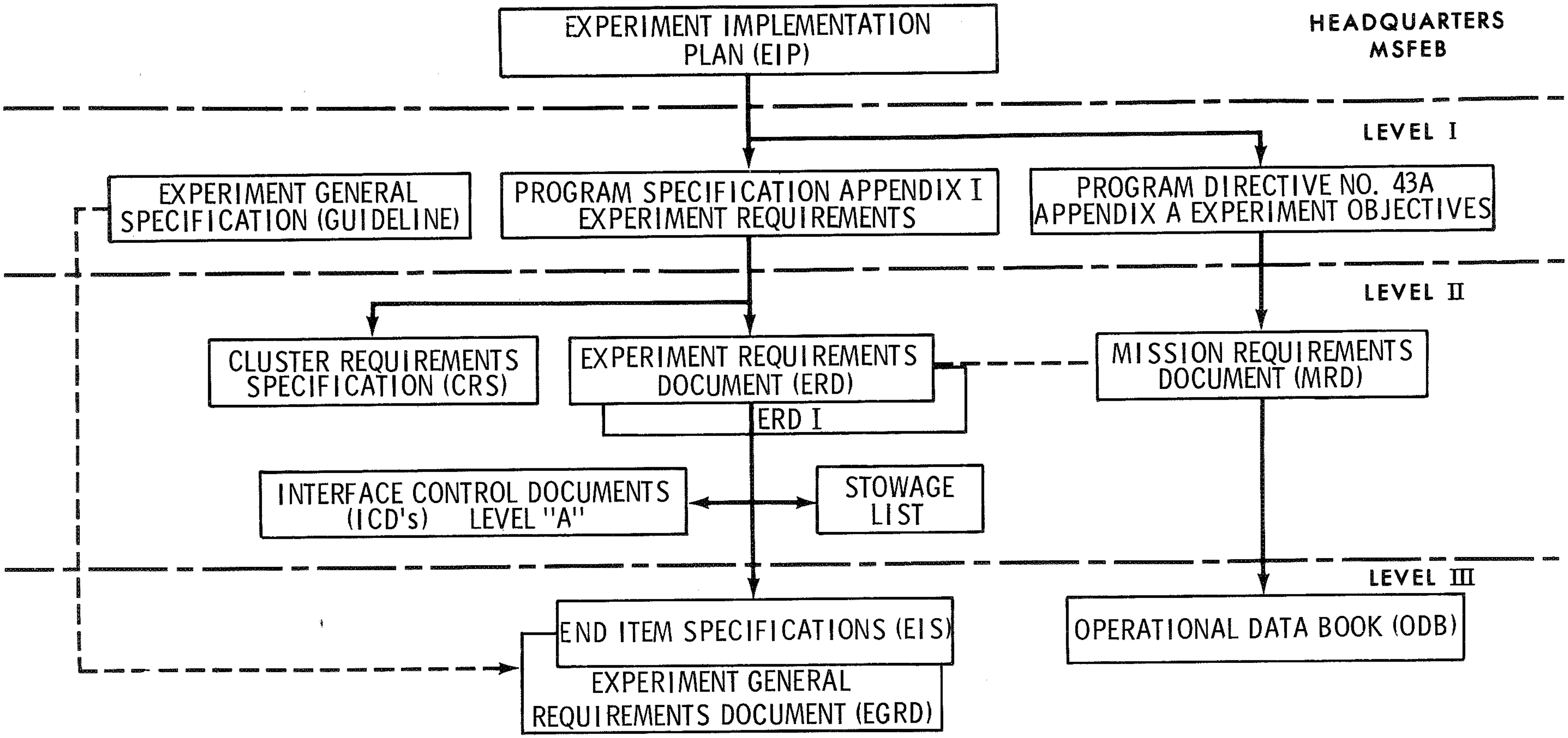
NASA-S-71-12802-V

SKYLAB DOCUMENTATION

Page intentionally left blank

NASA-S-71-13298-V

DOCUMENTATION TREE



EXPERIMENT IMPLEMENTATION PLAN (EIP)

HEADQUARTERS
MSFEB

LEVEL I

EXPERIMENT GENERAL SPECIFICATION (GUIDELINE)

PROGRAM SPECIFICATION APPENDIX I EXPERIMENT REQUIREMENTS

PROGRAM DIRECTIVE NO. 43A APPENDIX A EXPERIMENT OBJECTIVES

LEVEL II

CLUSTER REQUIREMENTS SPECIFICATION (CRS)

EXPERIMENT REQUIREMENTS DOCUMENT (ERD)

ERD I

MISSION REQUIREMENTS DOCUMENT (MRD)

INTERFACE CONTROL DOCUMENTS (ICD's) LEVEL "A"

STOWAGE LIST

LEVEL III

END ITEM SPECIFICATIONS (EIS)

EXPERIMENT GENERAL REQUIREMENTS DOCUMENT (EGRD)

OPERATIONAL DATA BOOK (ODB)

- TRAINING HARDWARE SPECIFICATIONS
- TEST AND CHECKOUT SPECIFICATIONS
- LEVEL "B" ICD's
- QUALITY AND RELIABILITY PLANS
- ACCEPTANCE DATA PACKAGE
- OPERATIONAL HANDBOOK
- SYSTEMS HANDBOOK
- PROGRAM SUPPORT REQUIREMENTS DOCUMENT

- EXPERIMENT OPERATIONS HANDBOOK
- FLIGHT OPERATIONS PLAN
- MISSION RULES
- CREW TRAINING PLAN
- FLIGHT PLAN
- TRAJECTORIES
- PHOTO OPERATORS PLAN

NASA-S-71-13286-V

EXPERIMENT IMPLEMENTATION PLAN (EIP)

- PURPOSE
  - TO PROVIDE GUIDELINES AND REQUIREMENTS FOR INITIATING EXPERIMENT DEVELOPMENT AND OPERATIONS PLANNING
- CONTENTS (NASA FORM 1347)
  - SUMMARY
  - TECHNICAL INFORMATION (OBJECTIVES, APPROACH, ETC.)
  - ENGINEERING INFORMATION (DESCRIPTION, INTERFACES, ETC.)
  - OPERATIONAL REQUIREMENTS (ORIENTATION, TRAINING, ETC.)
  - EXPERIMENT DEVELOPMENT APPROACH (RELIABILITY, QUALIFICATION, TEST)
  - INTEGRATION APPROACH (LOCATION, INTERFACES, ETC.)
  - PROGRAMMATIC INFORMATION (MANAGEMENT, COST, SCHEDULES)
- PREPARED BY EXPERIMENT DEVELOPMENT CENTER (EDC)
- SIGNED BY PI, EDC, EIC, AND LOC
- APPROVED FOR IMPLEMENTATION BY MSFEB
- CHANGES APPROVED BY MSFEB
- EXPERIMENT PLANNING AND IMPLEMENTATION PROCEDURES DESCRIBED IN PROGRAM DIRECTIVE NO. 15

NASA-S-71-13289-V

PROGRAM SPECIFICATION

- PURPOSE
  - FIRST LEVEL TECHNICAL SPECIFICATION DEFINING FUNCTIONAL AND PERFORMANCE REQUIREMENTS FOR SKYLAB SYSTEMS AND EXPERIMENTS
- CONTENTS (SPECIFICATION SE140-001-1)
  - SCOPE (SPECIFICATION TREE)
  - APPLICABLE DOCUMENTS
  - REQUIREMENTS (STANDARDS, OPERABILITY, PERFORMANCE)
  - APPENDIX I - EXPERIMENT REQUIREMENTS
  - APPENDIX II - CONTROL WEIGHTS AND LAUNCH VEHICLE PERFORMANCE
- PREPARED BY HEADQUARTERS, OMSF
- APPROVED BY SKYLAB PROGRAM DIRECTOR
- CHANGES APPROVED BY SKYLAB PROGRAM DIRECTOR
- LEVEL I CONFIGURATION MANAGEMENT PROCEDURES DESCRIBED IN NHB 8040.1
- HEADQUARTERS-TO-CENTER CONFIGURATION MANAGEMENT RELATIONSHIP DESCRIBED IN PROGRAM DIRECTIVE NO. 34

NASA-S-71-13285-V

OPERATIONS DIRECTIVE

- PURPOSE
  - MEANS BY WHICH THE SKYLAB PROGRAM DIRECTOR COMMUNICATES PROGRAMMATIC MISSION REQUIREMENTS TO THE IMPLEMENTING OFFICES AND CENTERS
- CONTENTS (PROGRAM DIRECTIVE NO. 43A)
  - DEFINES PROGRAM PURPOSE AND OBJECTIVES
  - PROVIDES EXPERIMENT MISSION ASSIGNMENTS AND CONSTRAINTS
  - PROVIDES FLIGHT SCHEDULING PRECEDENCE FOR COROLLARY EXPERIMENTS (EXCLUDES MEDICAL, ATM, AND EREP)
  - PROVIDES MISSION DESCRIPTION, OBJECTIVES, AND GUIDELINES FOR SL-1/SL-2, SL-3, AND SL-4
  - APPENDIX A DEFINES EXPERIMENT OBJECTIVES
- PREPARED BY HEADQUARTERS, OMSF
- APPROVED BY SKYLAB PROGRAM DIRECTOR
- CHANGES APPROVED BY SKYLAB PROGRAM DIRECTOR
- LEVEL I CONFIGURATION MANAGEMENT PROCEDURES DESCRIBED IN NHB 8040.1
- HEADQUARTERS-TO-CENTER CONFIGURATION MANAGEMENT RELATIONSHIP DESCRIBED IN PROGRAM DIRECTIVE NO. 34
- NEW OPERATIONS BASELINE AFFECTING THIS DOCUMENT HAS BEEN APPROVED BY THE MSFEB
- DOCUMENT REVISION (43A) TO BE DISTRIBUTED BY MARCH 31, 1971

NASA-S-71-13287-V

EXPERIMENT REQUIREMENTS DOCUMENT (ERD)

- PURPOSE
  - DEFINES THE EXPERIMENT EQUIPMENT AND PERFORMANCE REQUIREMENTS PLACED ON THE SPACECRAFT, FLIGHT CREW AND GROUND FACILITIES IN ORDER TO MEET THE EXPERIMENT OBJECTIVES
- CONTENTS (SE-010-001-2H, MSC-00921)
  - EXPERIMENT DESCRIPTION
  - MISSION ASSIGNMENT AND HARDWARE REQUIREMENTS
  - DATA REQUIREMENTS
  - FLIGHT VEHICLE SYSTEMS REQUIREMENTS
  - EXPERIMENT AND FLIGHT VEHICLE POINTING REQUIREMENTS
  - FLIGHT CREW OPERATIONS REQUIREMENTS
  - FLIGHT OPERATIONS REQUIREMENTS
  - POST ACCEPTANCE TESTING
  - RESUPPLY AND REACTIVATION REQUIREMENTS
  - REPORTS OF EXPERIMENT RESULTS
- PREPARED BY EXPERIMENT DEVELOPMENT CENTER (EDC)
- APPROVED BY PI, EDC, EIC AND LOC
- CHANGES APPROVED BY SKYLAB PROGRAM MANAGERS
- LEVEL II CONFIGURATION MANAGEMENT PROCEDURES DESCRIBED IN MSC-01160A

NASA-S-71-13288-V

MISSION REQUIREMENTS DOCUMENT (MRD)

- PURPOSE
  - DEFINES MISSION OPERATIONAL REQUIREMENTS AND PROVIDES THE BASIS FOR MISSION PLANNING AND DESIGN BY ALL ELEMENTS OF THE SKYLAB PROGRAM
- CONTENTS (I-MRD-001C)
  - MISSION DEFINITIONS
  - MISSION OBJECTIVES
  - MISSION REQUIREMENTS
  - MISSION DETAILED TEST OBJECTIVES (DTO's)
  - EXPERIMENT DTO's
- PREPARED BY THE MISSION OPERATION'S CENTER (MOC)
- APPROVED BY THE MOC AND EIC
- CHANGES APPROVED BY THE SKYLAB PROGRAM MANAGERS
- LEVEL II CONFIGURATION MANAGEMENT PROCEDURES DESCRIBED IN MSC-01160A
- UPDATED MRD TO BE DISTRIBUTED BY APRIL 30, 1971

NASA-S-71-13290-V

END ITEM SPECIFICATION (EIS)

- PURPOSE
  - DEFINES REQUIREMENTS APPLICABLE TO THE DEVELOPMENT OF SKYLAB EXPERIMENT HARDWARE BY THE MANNED SPACECRAFT CENTER (MSC)
- CONTENTS (MSC-KA-D-68-1 REVISION B)
  - CRITICALITY
  - APPLICABLE DOCUMENTS
  - TECHNICAL REQUIREMENTS (PERFORMANCE, INTERFACE, DESIGN)
  - QUALITY ASSURANCE REQUIREMENTS (INSPECTION, REPORTING)
  - RELIABILITY REQUIREMENTS (PLAN, FMEA, GFP)
  - VERIFICATION REQUIREMENTS (METHODS, TEST TYPES)
  - CONFIGURATION MANAGEMENT REQUIREMENTS (REVIEWS, CHANGE CONTROL)
  - DOCUMENTATION REQUIREMENTS (MANAGEMENT PLAN, PROCEDURES, ETC.)
- PREPARED BY EXPERIMENT DEVELOPMENT CENTER
- APPROVED BY THF SKYLAB PROGRAM MANAGER
- CHANGES APPROVED BY THE SKYLAB PROGRAM MANAGER
- LEVEL II AND III CONFIGURATION MANAGEMENT PROCEDURES DESCRIBED IN MSC-01160A

NASA-S-70-6508-V

FLIGHT PLAN PUBLICATIONS

● PRELIMINARY REFERENCE	LAUNCH (L) - 24 MONTHS
● REFERENCE	L - 14 MONTHS
● PRELIMINARY	L - 6 MONTHS
● FINAL	L - 2 MONTHS

NASA-S-70-6511-V

FLIGHT PLAN STATUS

- PRELIMINARY REFERENCE FLIGHT PLAN PUBLISHED OCTOBER 30, 1970 (JULY LAUNCH). REVIEW HELD DECEMBER 16, 1970
- INTERIM REVISION (NOVEMBER LAUNCH) PUBLISHED MARCH 1971
  - UPDATED SUMMARY TIMELINES FOR SL-2, -3, AND -4
  - BASED ON NOVEMBER 2, 1970 MRD
- REVISION A (APRIL LAUNCH) TO BE PUBLISHED AUGUST 1971
  - UPDATED SUMMARY TIMELINES FOR SL-2, -3, AND -4
  - DETAILED TIMELINE SL-2
  - BASED ON REVISED MRD REQUIREMENTS

NASA-S-71-13281-V

TRAJECTORY PUBLICATIONS

● PRELIMINARY REFERENCE	LAUNCH (L) - 24 MONTHS
● REFERENCE	L - 15 MONTHS
● OPERATIONAL SL 1/2	L - 9 MONTHS
● OPERATIONAL SL 3	L - 7 MONTHS
● OPERATIONAL SL 4	L - 4 MONTHS

NASA-S-71-13282-V

TRAJECTORY STATUS

- PRELIMINARY REFERENCE TRAJECTORY (PRT) FOR NOVEMBER 1972 LAUNCH PUBLISHED OCTOBER 13, 1970. DOCUMENT NO. MSC-02669
- REVISION 1 TO PRT PUBLISHED MARCH 2, 1971 FOR THE NOVEMBER 1972 LAUNCH. DOCUMENT NO. MSC-02669 REV 1
- REVISION 2 IS DUE TO BE PUBLISHED ON AUGUST 7, 1971. REVISION 2 TO THE PRT WILL BE FOR THE APRIL 1973 LAUNCH AND WILL INCLUDE ALL MISSIONS

NASA-S-71-13264-V

REQUIREMENTS DOCUMENTS

- 'MISSION REQUIREMENTS DOCUMENT, SKYLAB MISSIONS SL-1/SL-2, SL-3 AND SL-4', I-MRD-001C, DATED 2 NOVEMBER 1970
- 'EREP MISSION SCIENCE REQUIREMENTS DOCUMENT', VOL I, ROUGH DRAFT DATED 16 NOVEMBER 1970. FINAL PUBLICATION WILL BE RETITLED "EREP MISSION SCIENCE PLANNING DOCUMENT"

PLANNING DOCUMENTS

- 'SKYLAB PRELIMINARY REFERENCE FLIGHT PLAN, SL-2, SL-3 AND SL-4', MSC-03625, DATED 30 OCTOBER 1970
- 'SKYLAB PROGRAM OPERATIONAL DATA BOOK', MSC-01549

  VOL I - EXPERIMENTS PERFORMANCE DATA
  PART ONE - DOD, MEDICAL, ENGINEERING AND TECHNOLOGY
  PART TWO - SCIENTIFIC
  VOL II - MISSION MASS PROPERTIES
  VOL III - CSM PERFORMANCE DATA
  VOL IV - SKYLAB-1 PERFORMANCE DATA
  VOL V - CREW EQUIPMENT PERFORMANCE DATA

- 'PRELIMINARY REFERENCE TRAJECTORY', MSC-02669, REVISION 1 DATED 2 MARCH 1971

HANDBOOK DISTRIBUTION

- MSC DISTRIBUTION AND ADDITIONAL REQUESTS WILL BE HANDLED BY TF12/MARTHA JONES, RESEARCH DATA FACILITY, AGENA BUILDING X5968
- EARTH RESOURCES 'USER' AGENCY AND OTHER INVESTIGATORS OUTSIDE MSC SHOULD REQUEST COPIES FROM SRB/JOHN KOUTSANDREAS OSSA NASA HEADQUARTERS, WASHINGTON DC 202-962-0576

NASA — MSC — Coml., Houston, Texas